Intergovernmental Oceanographic Commission (of UNESCO)

World Meteorological Organization

# DATA BUOY COOPERATION PANEL

# REFERENCE GUIDE TO THE GTS-SUB-SYSTEM OF THE ARGOS PROCESSING SYSTEM

*REVISION 1.2*

DBCP Technical Document No.2
2003

## NOTE

# FOREWORD

The original Argos processing system was designed and implemented primarily to support the Global Weather Experiment in 1978/79. The processing requirement for the Global Telecommunication System (GTS) of WMO was intended to facilitate rapid global dissemination of data in standard format from the observation platforms (initially drifting buoys and constant level balloons) to the responsible research centres evaluating the observing systems. By the end of the 1980's, however, the diversity of users had expanded dramatically and it was apparent that the overall processing system was not well matched to the needs of either operational or research users of the Argos system. The DBCP and CLS/Service Argos together decided, therefore, to undertake the design and implementation of a new sub-system within the overall Argos processing system, specifically for the management of data destined for operational distribution over the GTS.

Specification for the Argos GTS Sub-system were subsequently prepared by the DBCP Technical Coordinator, Mr. Etienne Charpentier, and development of the sub-system was undertaken by a commercial company. Funding for the work was provided jointly by CLS/Service Argos, as an Argos development project, and by the DBCP. The sub-system finally became fully operational in 1993.

A Reference Guide to the Argos GTS Processing Sub-system was prepared and issued at that time (DBCP Technical Document No. 2) to assist Principal Investigators (PIs) running Argos programmes and wishing their data to be distributed on the GTS; PIs and manufacturers intending to design Argos platforms and messages for GTS distribution; and GTS users who receive data from the Argos centres. This guide has recently been updated to reflect various changes that have been made in the last few years and to clarify certain issues. The guide should be read in conjunction with the Guide to Data Collection and Services Using Service Argos (DBCP Technical Document No. 3), which provides details of the structure of the sub-system, and provides background on the system's various applications.

The Argos system has now become a very widely used and integral part of many worldwide programmes, and it is hoped this guide will assist further in extending the usage of the system. I am confident that the guide will continue and build on the good work of the previous issue. It is after all in the best interests of all involved in the marine meteorology and oceanography community, to have a reliable, timely and standardized method for exchanging data. I feel sure that this guide will assist PIs to distribute their buoy data on the GTS, and thus continue to increase the quantity and quality of such data available to support operational meteorology and oceanography.

In closing, I would like to thank Mr. Charpentier for his efforts in updating this guide, and commend its use to all users of the Argos system.

Graeme Brough
(Chairman, DBCP)

# Contents

# 1 - Who this guide is for

This guide is for:
• Principal Investigators (PIs) running Argos programmes and wishing the Argos processing centres to send data onto the Global Telecommunication System (GTS),
• PIs and manufacturers intending to design Argos platforms and messages for transmission onto the GTS,
• GTS users who receive data from the Argos centres.

We assume you are already familiar with the basic operation of the Argos system. For example, the guide does not discuss the type of transmitter you need to use Argos, or the daily number of satellite passes you can expect at your latitude. For information of this type, please contact an Argos User Office (see addresses in Annex B.1).

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§ 2 and 3 of this guide summarize the purpose of the GTS sub-system and how to use it.

§ 4 describes the three types of Argos messages and how they are processed, from reception by the satellite through to distribution on the GTS.

§ 5 describes how to define your requirements, essentially by filling in a Technical File.

§ 6 explains how the GTS sub-system deals with localizations.

§ 7 explains how the GTS sub-system compresses and quality-controls your message data.

§ 8 summarizes how Argos data are grouped into “observations”, which are formatted as “reports” for assembly into “bulletins”.

# 2 - The GTS sub-system at the Argos centres

## 2.1 - What it is for

Operational meteorologists rely on real-time data to run their numerical prediction models. The ground station network is dense and the data of good quality, but there is not enough data from the oceans, particularly in data-sparse areas not covered by commercial ships reporting weather data.

Many Argos platforms such as drifting and moored buoys, and even racing yachts, carry sensors to measure the geophysical variables needed, such as atmospheric pressure, air temperature, sea surface temperature, wind speed and direction. Principal Investigators of Argos programmes are therefore regularly asked for permission to send their data onto the GTS.

These data need decoding, processing into geophysical units, and quality-controlling. This is what the Argos GTS sub-system does. It also encodes the data according to World Meteorological Organization (WMO) formats for distribution onto the GTS. It is increasing both the quantity and the quality of Argos data sent onto the GTS.

The GTS sub-system operates at the Argos Global Processing Centres:
- Largo, Maryland in the United States,
- Toulouse, France.

You can both receive raw data on line from an Argos centre and have geophysical units sent through the GTS sub-system for GTS distribution (see Figure 1, below)

Before sending results onto the GTS the sub-system automatically traps data from failed sensors, and other bad data, by:
1. comparing data with limits you supply,
2. checking for gross errors,
3. compressing identical platform messages or sensor data from the same satellite pass,
4. using checksums to check message integrity, if you wish and if your platform message is compatible with this technique.

## 2.2 - The Global Telecommunication System

The GTS is a public international communication network for weather centres to exchange data gathered by their observation networks. It is coordinated by the World Meteorological Organization (WMO) World Weather Watch (WWW). The data are formatted using WMO GTS code formats such as BUOY for drifting buoys (see Annex C.1) and disseminated using formal WMO protocols.

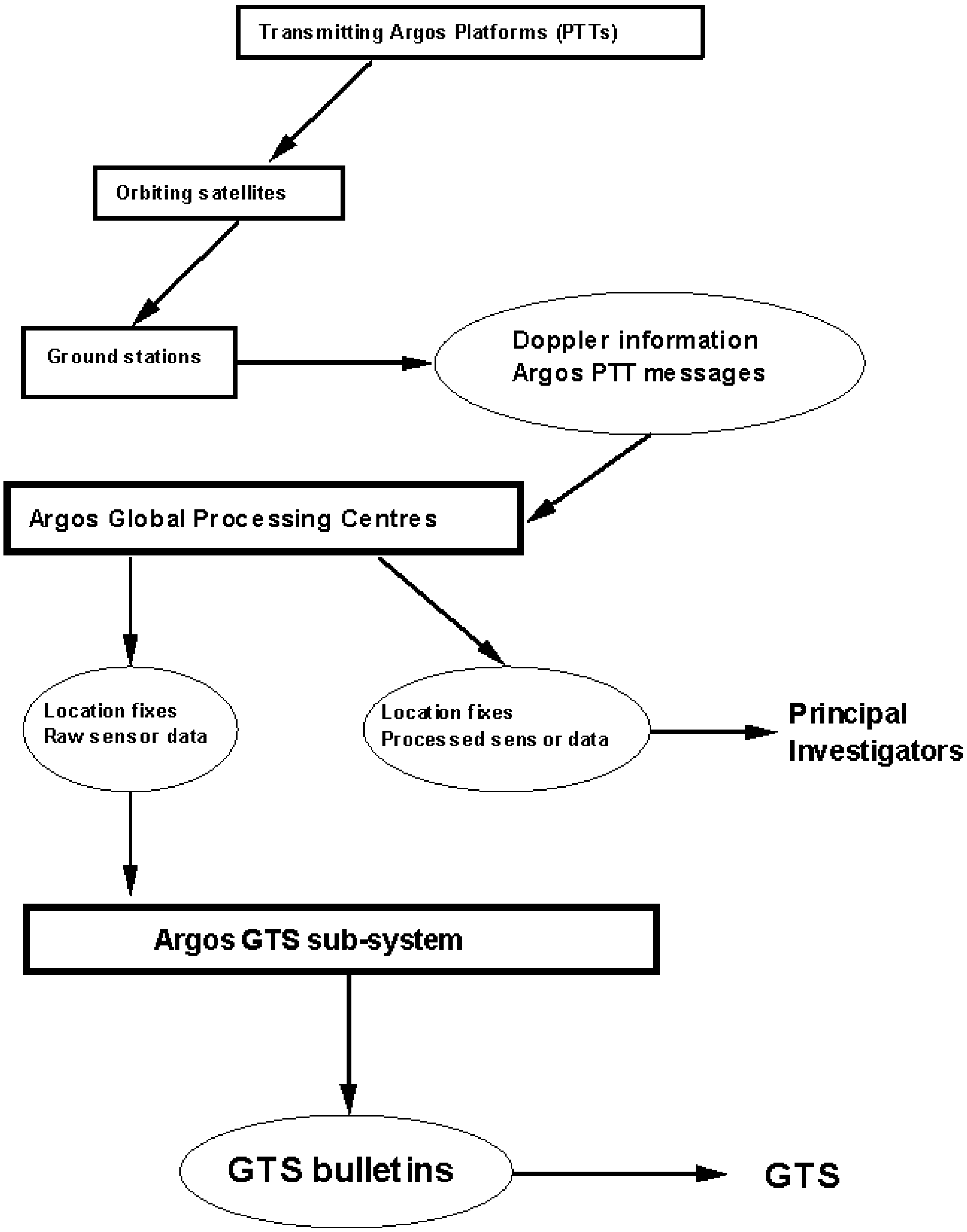



**Figure 1: sending Argos data onto the GTS**

## 2.3 - Advantages of the GTS sub-system for Argos users

The weather centres quality-control GTS data in delayed time. You are therefore informed if a sensor fails or needs recalibrating. Since the GTS sub-system is separate from the main Argos system, it does not affect the data delivered to Principal Investigators. For example, quality control and recalibrations have no impact on Argos data. The separation between the two systems also means you can receive the raw data while the processed data are distributed onto the GTS.

## 2.4 - No additional cost to Argos users

Argos recognizes the need for more cooperation in the environmental data user community. You pay no extra charges for the Argos centres to:
- handle your platforms for transmission of the data onto the GTS, e.g. declare your requirements in the system,
- send your data onto the GTS,
- provide help and advice.

## 2.5 - How to stop data from being sent onto the GTS

You can contact your Argos User Office at any time and request that GTS transmission of data from any of your platforms or programmes be stopped. If you intend to recover a platform please ask the Argos User Office in advance to remove it from the GTS. Please also let us know as soon as you know a platform is dying.

## 2.6 - How to get help

Feel free to contact your User Office or the Technical Coordinator of the DBCP[1] (TC-DBCP) at any time. An easy way to contact the User Office is Argos e-mail, using the MESS command. See Annex B, for TC-DBCP and User Office references.

[1] The Data Buoy Cooperation Panel (DBCP) is an official joint body set up by the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC). It was formally established in 1985. The DBCP's most important task is to internationally coordinate drifting buoy programmes. Substantial increases are expected in the number of buoys deployed on the global oceans and in the amount of good quality operational oceanic and atmospheric data available for the meteorological and oceanographic community. The DBCP is served by a full-time Technical Coordinator.

# 3 - How to have Argos data sent onto the GTS

## 3.1 - Have your programme approved

Your Argos programme must be approved in the regular way (if you are new to the Argos system please contact your Argos User Office, (addresses: Annex B.1). If you are starting a new programme, fill out a Programme Application Form and send it to your User Office for submission to the Argos Operations Committee. This takes about a month.

## 3.2 - Check that your data fits into a WMO format

The sensor data must be meteorological or oceanographic. The Argos GTS sub-system must also be able to convert the raw data into one of these GTS formats, sometimes known as code forms (see Annex C):

| Type of data | GTS format | |
|---|---|---|
| | **Name** | **Code** |
| Buoy observations | BUOY | FM 18-X |
| Land observations | SYNOP | FM 12-XI Ext. |
| Marine station observations | SHIP | FM 13-XI Ext. |
| Bathythermal observations | BATHY | FM 63-XI Ext. |
| Sub-surface temperature, salinity and current observations from a sea station | TESAC | FM 64-XI Ext. |
| Report from a hydrological stations | HYDRA | FM 67-VI |
| Binary Universal Form for the Representation of meteorological data | BUFR | FM 94-XI Ext. |

Note: BUFR is not available yet.

## 3.3 - Obtain WMO numbers for your platforms

Contact your National Weather Service or National Focal Point for Drifting Buoy Programmes (see Annex B.2) to request WMO identifier numbers for each platform (see Annex A). Your National Focal Point will also tell you if your country has any other procedures to follow for inserting data onto the GTS.

## 3.4 - Designate a Principal GTS Coordinator for your programme

We recommend you to designate a PGC, such as yourself if you are the Principal Investigator. The PGC will be the only person who can ask the Argos User Office to make changes impacting the data delivered onto the GTS, such as removing a platform from GTS distribution, removing or recalibrating a sensor, etc. The Technical Coordinator of the Data Buoy Cooperation Panel (TC-DBCP) will gladly be your PGC if you wish.

## 3.5 - Decide how you want your data processed

The GTS sub-system offers a wide variety of processing options, described in § 5 below. The way to define how you want us to process your data is by filling out a GTS Technical File, available from your User Office. Feel free to contact the TC-DBCP for any help you need.

The other information to provide to your User Office is:
- Quality Control: which of the available options you wish to use. The six QC checks described in § 7 can be turned on or off on request,
- information you wish us to include in your GTS bulletins: see § 8.2.

## 3.6 - Test some processing options

To see which options give the best results, it is often possible to simulate an Argos/GTS programme with raw data telemetry. If you are interested, please contact the TC-DBCP. Requests are examined on a case-by-case basis.

# 4 - Argos messages and message processing

## 4.1 - Types of sensor

The Argos message (also known as the PTT message, for Platform Transmitter Terminal) contains the data your platform sends to the satellite, either instantaneously or from memory. The data is split into words, often called "sensors". The Argos message can contain 32 to 256 data bits. Bits are numbered 0 to 255.

Data words can be:

-a- "Regular sensor": geophysical measurements (e.g. Air Pressure).

-b- "Timer": words containing information related to the observation time of regular sensors.

-c- "Checksum": words containing information calculated by the platform for validating data transmission and message integrity.

-d- "Block": Number of times a block of information is repeated in the Argos message (e.g. repeating Temp/Depth for a temperature profile).

## 4.2 - Producing GTS bulletins from platform messages

Whenever one of the satellites in the Argos system passes within range of a transmitting Argos platform, it collects messages. It stores these on board and transmits them to the Argos processing centres via ground stations in real or delayed time.

The processing centres compute the platform locations (if your platform is location-type) and compress identical messages. If you do not specify otherwise, only the message received identically most often during the satellite pass (known as the message with the highest compression index) is processed. The compressed message is decoded according to information you provide in your Technical File.

GTS bulletins containing GTS reports coded according to WMO regulations are then produced and sent in real time to operational meteorological and oceanographic centres.

Data from one platform and one satellite pass can produce more than one report in the following situations:

- You requested more than one GTS code form (e.g. BUOY and BATHY)

- The satellite received more than one observation during the same satellite pass (an observation is the set of sensor information available from a transmitter at a given time).

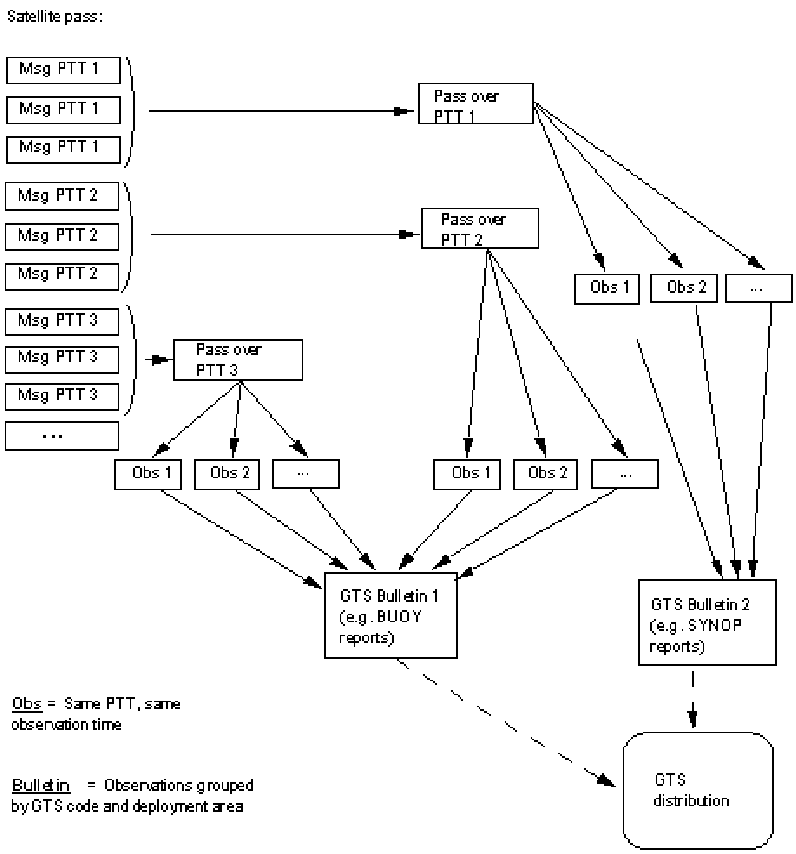



**Figure 2: how GTS bulletins are generated from transmitter (PTT) messages**

# 5 - Defining your data and processing requirements

To have your sensor data processed into physical units by the GTS sub-system and sent onto the GTS, you can define the following:

| Definition | See below | Where to specify it |
|---|---|---|
| **Platform**: type, initial position, etc. | § 5.1 | GTS Technical File |
| **Binary format**: e.g. pure binary | § 5.2 | Contact an Argos User Office or the TC-DBCP[1] |
| **Transfer function**: how you want your raw data converted, e.g. using a polynomial function. | § 5.3 | GTS Technical File |
| **Corrections**: e.g. for geomagnetic variation | § 5.4 | Contact an Argos User Office or the TC-DBCP[1] |
| **Associated sensors**, e.g. to provide the depth of a temperature measurement, timers, etc. | § 5.5 | Contact an Argos User Office or the TC-DBCP[1] |
| **Extra GTS format**: e.g. use both SHIP and BATHY (not recommended) | § 5.6 | Contact an Argos User Office or the TC-DBCP [1] |
| **Observation time**: e.g. report your measurements according to UTC time | § 5.7 | GTS Technical File |
| **Multiplexing**: if 256 bits are not enough, you can spread data over several Argos messages | § 5.8 | Contact an Argos User Office or the TC-DBCP [1] |
| **Repeating blocks** of information in Argos messages (e.g. temp/depth profiles) | § 5.9 | Contact an Argos User Office or the TC-DBCP [1] |

[1]If the technical specifications of your Argos transmitter do not match the information requested in GTS Technical File, they may still be compatible with the GTS sub-system. Please contact your User Office or the TC-DBCP and submit the specifications in your own format. Requests are examined on a case-by-case basis.

## 5.1 - Platform

Enter the following information in your Technical File. Again, if the technical specifications of your Argos transmitter do not match the information requested in the GTS Technical File, please contact your Argos User Office or the TC-DBCP and submit the specifications in your own format:

- Type of platform (e.g. drifting buoy, moored buoy, fixed platform, ship). Quality control procedures depend upon the type of platform. For example very old locations can be used for fixed platforms or moored buoys, but drifter locations older than a couple of days are not sent onto the GTS.

- Initial position of platform and date of deployment.

- Name of international experiment to which platform belongs (e.g. WOCE, TOGA), if any.

- WMO number (see Annex A).

- Number of bits in Argos message.

- Any multiplexing methods used, with format (see § 5.8).

- For drifting buoys, whether it is a Lagrangian drifter, whether a drogue is present, and if any the depth and shape of the drogue (e.g. holey sock). If requested, drogue information can be coded in BUOY messages (see Annex C.1). If the drogue detaches tell the Argos User Office so that the drogue information can be updated in your GTS messages.

- List of sensors to be sent onto the GTS, with a description of each sensor status.

- List of requested GTS code forms needed for GTS distribution, plus GTS bulletin header information.

## 5.2 - Binary format

The processing centre obtains the binary value of each word from its position in the Argos message, the number of bits, and the binary format. Bits are numbered from 0 (first, most significant bit) to 255 (last, least significant bit). The number of bits in a word can vary from 1 to 31.

You can define the following binary formats:

| Format | Example | |
|---|---|---|
| | **Decimal** | **Binary coding** |
| **Pure binary**, e.g. 4 bits: | +15 | 1111 |
| **Pure binary in twos-complement**, e.g. 4 bits: | -1<br>+7 | 1111<br>0111 |
| **Signed binary**, e.g. 4 bits: | -7<br>+7 | 1111<br>0111 |
| **Binary-Coded Decimal (BCD)**, 4 bits per digit e.g. 2 digits, 8 bits: | 87 | 10000111 |
| **ASCII**, e.g. 8-bit characters: | 31 | 00110011 and 00110001 |
| **Gray code** | | |
| **Point number within block** (see paragraph 5.9). By convention, first point in block has value 1. Remark: this is not strictly speaking a binary format since point number will be taken in place of a specific data word in the Argos message. | Not applicable | Not applicable |

In addition, **binary words can be permuted**, i.e. binary word in cut in two halves and then those halves are permutted, e.g. 00001111 => 11110000 (if number of bits are odd, permutation is done as on the following example: 0001111 => 1111000).

When decoding binary words, the GTS sub-system first extracts the bits and then permutes the half words if permutation was requested by the users. Then binary formats as described above are applied.

## 5.3 - Transfer functions

The processing centres will use your transfer function to convert the binary data into physical units as indicated in Table 1 after paragraph 5.6 (e.g. Air Pressure data converted to hectoPascals (hPa)).

Transfer functions available:

**B1**: Calibration table (up to 20 points), linear interpolation between points. See § 5.3.1.

**B2**: Calibration table with compensating sensor, linear interpolation between points. See § 5.3.2.

**B3**: Polynomial function with break point and compensating sensor. See § 5.3.3.

**B4**: Polynomial function with compensating sensor up to degree 5. See § 5.3.4.

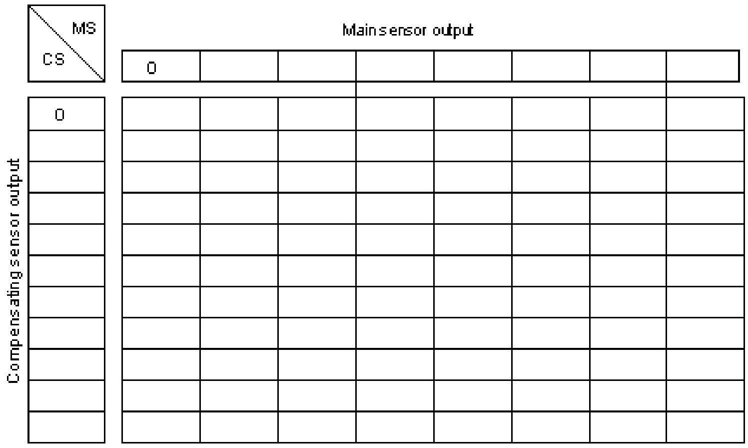
**SM**: Software Module: a dedicated module (e.g. FORTRAN program) can be implemented to convert raw data into physical units. Example: Laplace module for reducing air pressure to sea level. See § 5.3.5.

### 5.3.1 - B1 (calibration table, linear interpolation)

| | Sensor output | Physical output | | Sensor output | Physical output |
|---|---|---|---|---|---|
| 1 | 0 | | 11 | | |
| 2 | | | 12 | | |
| 3 | | | 13 | | |
| 4 | | | 14 | | |
| 5 | | | 15 | | |
| 6 | | | 16 | | |
| 7 | | | 17 | | |
| 8 | | | 18 | | |
| 9 | | | 19 | | |
| 10 | | | 20 | | |

- The first entry in the table must correspond to a sensor output with all bits set to zero.
- The last entry in the table must correspond to a sensor output with all bits set to 1 (e.g. 24 for an 8-bit sensor).
- Entries must be arranged in order of increasing sensor output.
- There must be 2 to 20 physical values.

### 5.3.2 - B2 (calibration table with compensating sensor, linear interpolation)




Comments:

- The table consists of physical values and may contain a maximum of 11 columns and 9 rows.
- Sensor output corresponds to raw decimal values extracted from platform message, according to your defined binary format.
- The first entry in the table must correspond to a sensor output with all bits zero.
- The last entry in the table must correspond to a sensor output with all bits set to 1 (e.g. 24 if an 8-bit sensor).
- Entries must be arranged in order of increasing sensor output.

### 5.3.3 - B3 (polynomial function with break point and compensating sensor)

- Algorithm:

IF $X_j$<TC THEN $X_j=X_j+2^{n_j}$
$X_j=A*X_j+B$
IF $X_i$<PC THEN $X_i=X_i+2^{n_i}$
$R=C_1+C_2*X_j+C_3*X_i+C_4*X_i^2$

where:
R is the result of B3 processing, i.e. the computed physical value.
TC is the compensating sensor break point
$X_i$ and $X_j$ are the main and compensating sensor outputs respectively, i.e. raw decimal values extracted from PTT message, using your defined binary format,
$n_i$ and $n_j$ are the number of bits output by the main and compensating sensors, respectively,
PC is the main sensor break point.

### 5.3.4 - B4 (polynomial function with compensating sensor)

- Function:

$$R=A_0 + A_1*X_i+A_2*X_i^2+A_3*X_i^3+A_4*X_i^4+A_5*X_i^5$$
$$+ B_1*X_j+B_2*X_j^2+B_3*X_j^3+B_4*X_j^4+B_5*X_j^5$$

where:
R is the result of B4 processing, i.e. the computed physical value,
$X_i$ and Xj are the main and compensating sensor outputs respectively, i.e. raw decimal values extracted from the platform message, using your defined binary format.

### 5.3.5 - SM (software module)

For transfer functions which B1, B2, B3, or B4 processing cannot approximate accurately enough, you can have a dedicated FORTRAN subroutine (SM) implemented in the GTS processing sub-system. It can be assigned to any defined sensor on any PTT, with 20 coefficients per sensor.

Please submit your specifications to the Argos User Office. Do not exceed 25 lines of FORTRAN. Based on the complexity of the task, the Argos system operator CLS may or may not agree. Software modules are for converting raw sensor data into geophysical values, and may not be used for, say, time computation.

Notation:

**Count:** Main sensor raw value as encoded in Argos message

**Count_Comp:** Compensating sensor raw value

**Phys:** Processed physical value of main sensor

**Phys_Comp:** Processed physical value of compensating sensor (if any)

**Phys_Comp2:** Processed physical value of second compensating sensor (if any)

**$c_1$ .. $c_{20}$:** Calibration coefficients (each sensor of any platform is assigned a dedicated coefficient)

General form:

```
SUBROUTINE SOFTWARE_MODULE ( Input:Count,
                             Input:Count_Comp,
                             Input:Phys_Comp,
                             Output:Phys )
```

The software modules available at the time of writing (September 2001) are:

*5.3.5.1 - **IDENTITY** module*

Simply copies raw sensor value into sensor geophysical value without converting, i.e.:

Phys = Count

*5.3.5.2 - **TEMP_LOGA** module*

For temperature sensors with transfer functions in the following form:

IF there is a compensating sensor #1 then
    X = Physical value of compensating sensor # 1
Else
    X = Binary decimal value of main sensor (Count)
Endif

| | | |
|---|---|---|
| Resistance | = | $(c_1 * X + c_2) / (c_3 * X + c_4)$ |
| Y | = | $LOG(Resistance)/LOG(c_5)$ |
| Phys | = | $c_6 / (c_7 + c_8*Y + c_9*Y^2 + C_{10}*Y^3) - c_{11}$ |

*5.3.5.3 - **POLYN_XY** module*

For sensors with transfer functions in the following form:

X = Count (or Phys_Comp2 in case a 2nd compensating sensor is used)

Y = Phys_Comp

$$\begin{aligned}Phys = {} & c_1 + c_2*X + c_3*X^2 + c_4*X^3 + c_5*X^4 + \\ & c_6*Y + c_7*Y^2 + c_8*Y^3 + c_9*Y^4 + \\ & c_{10}*X*Y + c_{11}*X*Y^2 + c_{12}*X*Y^3 + \\ & c_{13}*X^2*Y + c_{14}*X^2*Y^2 + \\ & c_{15}*X^3*Y\end{aligned}$$

This makes it possible to encode incremental values of a sensor relative to another sensor (e.g. Phys = Phys_Comp + $c_2$*Count ).

**Attention:** There is now the possibility to have a second compensating sensor declared for each main sensor. If this is the case, then value X is not the binary value of the main sensor (count) but the physical value of the second compensating sensor.

*5.3.5.4 - **POLYN_XZY** module*

For sensors with transfer functions in the following form:

X = Binary decimal value of main sensor
If ($c_1$=0) or Compensating sensor #1 found (by real time)
    Y = Physical value of compensating sensor # 1
Else
    Y = Physical value of compensating sensor # 2
Endif
Z = Physical value of compensating sensor # 2

$$Phys = c_2 + c_3*X + c_4*Y + c_5*Z + c_6*X*Y + c_7*X*Z + c_8*Y*Z + c_9*X*Y*Z + c_{10}*X^2 + c_{11}*Y^2 + c_{12}*Z^2 + c_{13}*X^3 + c_{14}*Y^3 + c_{15}*Z^3$$

**Remark**: When using blocks, this makes it possible to encode incremental values of a sensor relative to (i) an initial value outside the block, or (ii) the preceeding value withing block, e.g.

Phys=Preceeding_Phys+Delta_Phys

Where

Phys: main sensor (declared using bits for delta value)
Delta_Phys: delta value as encoded in block (X)
Preceeding_Phys: Preceeding physical value of sensor (Y), i.e. $Phys_0$ (outside the block declared as $2^{nd}$ compensating sensor) or preceeding value within block of the main sensor (previous Phys declared as $1^{st}$ compensating sensor).

*5.3.5.5 - **ATLAS** module*

For TOGA TAO array ATLAS moored buoys (in the Equatorial Pacific Ocean). May also be useful for platforms using the types of sensor data processing shown below, according to the value of $c_1$.

**If $c_1$ = 1 then (Temperature)**

Z = 768000000 / (2.525*Count - 7680)
X = LOG10 ($c_5$ + $c_6$*Z)
Phys = 1/($c_2$ + $c_3$*X + $c_4$*$X^3$) - 273.15

**Else If $c_1$ = 2 then (Water Pressure)**

Phys = 0.68947*($c_2$ + (76800*$c_3$/Count))

**Else If $c_1$ = 3 then (Wind)**

(Wind is encoded in the Argos message using U and V vector components. The Main sensor represents V (before processing) and wind direction (after processing); the Compensating sensor represents U (before processing) and wind speed (after processing))

U=Count_Comp
V=Count
If U >= 128 then U = U - 256 Endif
If V >= 128 then V = V - 256 Endif
U = $c_2$*U
V = $c_2$*V
SPEED = $c_5$ + $c_6$*SQRT ($U^2$+$V^2$)
If V=0 Then
    If U = 0 then DIR = 0 Endif
    If U < 0 then DIR = 270 Endif
    If U > 0 then DIR = 90 Endif
Else
    If (U>=0) and (V>0) then DIR = ArcTan(ABS(U/V)) Endif
    If (U>=0) and (V<0) then DIR = 180-ArcTan(ABS(U/V)) Endif
    If (U<0) and (V<0) then DIR = 180+ArcTan(ABS(U/V)) Endif
    If (U<0) and (V<0) then DIR = 360-ArcTan(ABS(U/V)) Endif
Endif
DIR = 180 + $c_4$*DIR
If (Automatic Geo-Magnetic Correction Not Requested) then
    DIR = DIR + $c_3$
Endif
If (DIR < 0) then DIR = DIR + 360 Endif
If (DIR >= 360) then DIR = DIR - 360 Endif
Phys_Comp = SPEED
Phys = DIR

**Else If $c_1$ = 5 then (Temperature)**
$Z = 307200000 / Count$
$X = LOG10 (c_5 + c_6*Z)$
$Phys = 1/(c_2 + c_3*X + c_4*X^3) - 273.15$

**Else If $c_1$ = 6 then (Temperature)**
$Y = c_5 + c_6*(5*Count/1024)$
$Phys = c_2 + c_3*Y$

**Else If $c_1$ = 7 then (Temperature)**
$Z = 400000000 / Count$
$X = LOG10 (c_5 + c_6*Z)$
$Phys = 1/(c_2 + c_3*X + c_4*X^3) - 273.15$

**Else If $c_1$ = 8 then (Humidity)**
$Phys = c_2 + c_3*(Count/2.56)$
**End if**

*5.3.5.6 - **MARISONDE** module*

For temperature sensors on buoys with thermistor strings (Météo-France).

**If Phys_Comp is out of limits then**
Phys forced to an out of limits value
**Else**
$U = c_1 * Count + c_2$
$V = INT((Phys\_Comp - U + 1)/(256 * c_1))$
$Phys = U + V * 256 * c_1$
**Endif**

*5.3.5.7 - **LAPLACE** module: Reduction to Sea Level, Geopotential*

Reduces air pressure to sea level or computes geopotential of an isobaric surface at a standard pressure level (i.e. 1000, 500, 700, or 850 hPa).

For land meteorological stations making air pressure measurements at station level when sea level pressure or geopotential is required for GTS distribution.

Assumptions:
- air relative humidity is constant throughout the year for the air layer considered,
- air temperature varies with a vertical gradient of -0.65 Celsius per 100 meters of elevation,
- main sensor measures air pressure at station level,
- If there is no 2nd compensating sensor, then transfer function for main sensor is assumed linear: station level pressure = $c_1 + c_2 * Count$.
- If there is a 2nd compensating sensor, then physical value of that sensor (Phys_Comp2) is assumed to be air pressure at station level in hPa and Count value of main sensor is ignored.
- compensating sensor measures air temperature (if applicable). If not measured, air temperature is assumed constant throughout the year.

The processed physical value of the main sensor will be pressure reduced to sea level or geopotential as required.

Module coefficients:

$c_1$: **Offset** for computation of air pressure (hPa) at station level (Pressure = c1 + c2*Count). Used only if there is no 2nd compensating sensor which returns air pressure at station level directly (Phys_Comp2).

c2: **Slope** for computation of air pressure (hPa) at station level (Pressure = c1 + c2*Count). Used only if there is no 2nd compensating sensor which returns air pressure at station level directly (Phys_Comp2).

c3: **Mean annual air temperature** (°C) at station location if no air temperature sensor is available.

c4: **Mean air relative humidity** (%) of air layer considered at station location.

c5: 1 if **Sea Level Pressure** is required
0 if **geopotential** is required (PI defines isobaric surface to be used for all platform sensors).

*5.3.5.8 - **AWI (Alfred Wegener Institute)** module*

Computes air pressure using algorithm below.

Main sensor: Air Pressure.
Compensating sensor: internal temperature.

$X = \text{Count}$
$Y = \text{Phys\_Comp}$

$P_0 = \mathbf{c_1} - X * (\mathbf{c_2} + X * \mathbf{c_3})$
$P_1 = \mathbf{c_4} - X * (\mathbf{c_5} + X * \mathbf{c_6})$
$P_2 = \mathbf{c_7} - X * (\mathbf{c_8} + X * \mathbf{c_9})$
$Q_0 = P_1$
$Q_1 = (P_0 - P_2) / \mathbf{c_{10}}$
$Q_2 = ((P_0 + P_2) / \mathbf{c_{11}}) - Q_0$
$R = (Y + \mathbf{c_{12}}) / \mathbf{c_{13}}$
$\text{Phys} = Q_0 + (R * (Q_1 + R * Q_2))$

*5.3.5.9- **DEWPOINT** module: Air Dew Point Temperature based on Relative Humidity and Air Temperature.*

Computes the Air Dew Point Temperature based on values of Relative Humidity (main sensor or 2nd compensating sensor), and Air Temperature (compensating sensor).

Assumptions:
- main sensor measures air Relative Humidity,
- If there is no 2nd compensating sensor, then transfer function for main sensor is assumed linear: Humidity = c1+c2*Count.
- If there is a 2nd compensating sensor, then physical value of that sensor (Phys_Comp2) is assumed to be air relative humidity in % and Count value of main sensor is ignored.
- compensating sensor measures Air Temperature. If Air Temperature is not measured, or not valid, Dew Point Temperature is forced out of limits.

The processed physical value of the main sensor will be the Air Dew Point Temperature. Module coefficients are:

c1: **Offset** for computation of air Relative Humidity (%) at station level (Offset = c1 coefficient, Humidity = c1 + c2*Count). Used only if there is no 2nd compensating sensor which returns air relative humidity directly (Phys_Comp2).

c2: **Slope** (c2 coefficient) for computation of air Relative Humidity (%) . Used only if there is no 2nd compensating sensor which returns air relative humidity directly (Phys_Comp2).

*5.3.5.10- **SAL78** module: Computation of water salinity based upon conductivity, temperature, depth:*

Main sensor: Conductivity sensor

Compensating sensor: Temperature sensor in Celsius (physical value of compesating sensor is used here for temperature).

2nd Compensating sensor: Optional, water pressure in Deci-Bars (Phys_Comp2). If there is no 2nd compensating sensor, value of coefficient c3 is taken for constant average water pressure (in Deci-Bars).

SAL78 computes salinity based on conductivity and temperature. Conductivity is obtained as a linear function of main sensor count: Conductivty = c1 + c2*Count

Conductivity is expressed here in MilliSiemens/cM. Obtained salinity is expressed in psu (Practical Salinity Units,part per thousand).

c1: Offset for computing conductivity
c2: Slope for computing conductivity
c3: Average water pressure

<u>Remark</u>: For the computation, the algorithms uses and computes so called Conductivity Ratio defined as Conductivity divided by Conductivity of standard seawater of 35 psu salinity, 15C temperature, and standard surface atmospheric pressure.

*5.3.5.11- **SIGNATURE** module: Computation of the signature of an Argos message.*

Signature of an Argos message is a real number (32 bits) computed based

$$\sum_{i=1}^{32} Octet_i \Rightarrow 13 \text{ bits} \qquad \sum_{i=2}^{32} Abs(Octet_i - Octet_{i-1}) \Rightarrow 13 \text{ bits}$$

upon the value of a whole Argos message. The 32 bits of the Argos message signature are computed as follows (13+13+6 bits):

$$\left(\sum_{i=1}^{32} Octet_i^2\right) \text{modulo } 64 \Rightarrow 6 \text{ bits}$$

Obtained 32 bits (I) are transformed into a real number using following formula: Phys=I+(10000*(I modulo 10000)).

*5.3.5.12- **TABLE** module: extraction of physical value from a table*

IF there is a compensating sensor #2 then
    X = Physical value of compensating sensor # 2
Else
    X = Binary decimal value of main sensor (Count)
Endif
Y = Corrected Physical Value of 1st Compensating Sensor

Phys = $c_4 + c_5$*TABLE $(c_1$*X $+ c_2$*Y $+ c_3)$

TABLE is given in the lines of text of module for the considered sensor: Values separated by comas (,), e.g.

950.1,900.0,850
750.1,700,654.55,500.77
…

*5.3.5.13- **PRESDEDUC** module: extraction of physical value from a table*

A table TABLE is provided by the principal investigator. Table is sorted by increasing geo-physical values (first value has index 1), values are sperated by comas (e.g. 1000,950.1,800,750 ...).

Y = Corrected Physical Value of 1st Compensating Sensor
Y_Index = Index in the table of Y or of value immediately preceeding Y in the table

Phys = TABLE($c_1$ + Y_Index + 1)

This module is used when an approximate value for Phys is known and correct value can only be found from closest value in a table.

## 5.4 - Corrections

### 5.4.1 - Geomagnetic variation correction

For buoys measuring wind direction using compass, data can be automatically corrected for takinf geomagnetic variations into account. The correction depends upon the observation time and the platform position. The GTS sub-system computes a geomagnetic variation for that time and the platform position using the World Chart 2000 global field Geomagnetic variation model (IGRF 2000) which was obtained from the Geomagnetic Data Group of the NOAA National Geophysical Data Center (http://www.ngdc.noaa.gov/seg/potfld/geomag.shtml). Version is valid for the period 2000-2005. It then automatically adds the correction (modulo 360) to the wind direction measurements before GTS distribution.

### 5.4.2 - Linear correction

Instead of modifying a complete calibration curve, the GTS sub-system can slightly modify any sensor data sent onto the GTS by applying linear corrections to all physical values for the sensor (i.e. phys=phys.a+b, where a and b are provided by the PI).

This linear correction is independent of the transfer function.

a is initialized at 1 and b at 0.

For example, a Air Pressure sensor might need recalibrating by adding 3.4 hPa (a=1, b=3.4) or a wind speed sensor by applying a rate factor of 1.24 (a=1.24, b=0).

## 5.5 - Associated sensors

Extra sensor words can help to interpret the output of, or report on the status of, a main sensor:

### 5.5.1 - Compensating sensors

The final result from a geophysical measurement is computed from the binary output of a main sensor and from another sensor word called the compensating sensor. For example a main Air Pressure Sensor can be compensated by an Internal Temperature sensor whose binary values are also coded into the Argos message. Compensating sensors can only be used with B2, B3, B4 and SM processing.

Certain SM modules do accept a $2^{nd}$ compensating sensor.

### 5.5.2 - Level sensors

If a sensor makes measurements at different levels or depths, e.g. XBT water temperature measurements, a sensor can encode the levels into the Argos message. A level sensor must be defined with a B1, B2, B3, B4 or SM calibration curve and be associated with one or more sensors.

If the level is constant and defined, e.g. Salinity at 50 meters, a level sensor is unnecessary.

### 5.5.3 - Duplicated sensors

If a platform has two or more similar sensors (e.g. two Air Pressure sensors), its data can be sent onto the GTS according to the priorities you define. Hence, if Quality Control rejects the first sensor value in the list, the GTS sub-system will process the next sensor value in the list.

### 5.5.4 - Time sensor

A timer can provide the measurement time. See § 5.7 for details.

### 5.5.5 - Checksum sensors

Checksums validate sensor data on reception at the processing centres to prevent bad data going onto the GTS. (Degradation can occur in the platform-to-satellite link or satellite-to-ground link, or at the processing centre). See § 7.3.2 for details.

## 5.6 - Using more than one format

Platform sensors can each use different code forms to report onto the GTS. For example, if a platform has Air Pressure, Air Temperature, Sea Surface Temperature, and Sub-Surface Temperature sensors, it can report onto the GTS using SHIP code for surface measurements (Air Pressure, Air Temperature, Sea Surface Temperature) and BATHY for Surface and Sub-Surface Water Temperature. However, we recommend that you use only one code form per sensor. See Annex C for details.

# Table 1: Geophysical variables, with units and formats.

| *Mnemo* | *Code* | *Variable* | *Units* | *Buoy* | *Synop* | *Ship* | *Bathy* | *Tesac* | *Hydra* | *Bufr* |
|---|---|---|---|---|---|---|---|---|---|---|
| AI_GEOP | 33 | Geopotential | M | | * | * | | | | * |
| AI_HUM | 31 | Air Relative Humidity | % | * | * | * | | | | * |
| AI_P | 3 | Atmospheric Pressure | hPa | * | * | * | | | | * |
| AI_PT | 4 | Air Press Tendency (>0) | hPa/3H | * | * | * | * | | | * |
| AI_PTC | 5 | Charact of Pr. Tend. | Table | * | * | * | | | | * |
| AI_PTS | 16 | Sign of pressure tendency | / | | | | | | | * |
| AI_PV | 50 | Air Press Variation | hPa/3H | * | * | * | * | | | * |
| AI_SLP | 32 | Sea Level Pressure | hPa | * | * | * | | | | * |
| AI_T | 2 | Air Temperature | C | * | * | * | * | * | * | * |
| AI_TD | 30 | Air Dew Point | C | * | * | * | | | * | * |
| AI_TN06 | 39 | Air Temp (Min.) in 6 hrs | C | | * | * | | | | * |
| AI_TN12 | 38 | Air Temp (Min.) in 12 hrs | C | | * | * | | | | * |
| AI_TN24 | 37 | Air Temp (Min.) in 24 hrs | C | | * | * | | | * | * |
| AI_TX06 | 42 | Air Temp (Max.) in 6 hrs | C | | * | * | | | | * |
| AI_TX12 | 41 | Air Temp (Max.) in 12 hrs | C | | * | * | | | | * |
| AI_TX24 | 40 | Air Temp (Max.) in 24 hrs | C | | * | * | | | * | * |
| ALTITUDE | 57 | Altitude of station | m | | | | | | | * |
| CU_DI, l<0 | 11 | Current direction | Deg | * | | | | * | | * |
| CU_DI, l=0 | 11 | Surface Current Dir. | Deg | * | | | * | * | | * |
| CU_SP, l<0 | 10 | Current Speed | cm/s | * | | | | * | | * |
| CU_SP, l=0 | 10 | Surface Current Speed | cm/s | * | | | * | * | | * |
| DEFAULT | 1000 | Default type of sensor | / | | | | | | | * |
| DEPTH | 100001 | Depth of probe | m | * | | | * | * | | * |
| DISCHARGE | 44 | Discharge hydro sta. | dm$^3$/s | | | | | | * | * |
| HK#1 | 12 | Housekeeping Param. | Free | * | | | | | | * |
| HK#2 | 13 | Housekeeping Param. | Free | * | | | | | | * |
| HK#3 | 14 | Housekeeping Param. | Free | * | | | | | | * |
| H_VISI | 34 | Horizontal Visibility | m | | * | * | | | | * |
| ICE_THICK | 48 | Ice Thickness | cm | | | | | | * | * |
| INT_T | 100000 | Internal platform temp. | C | | | | | | | * |
| LATITUDE | 58 | Latitude of station | Deg. | * | | * | * | * | | * |
| LONGITUDE | 59 | Longitude of station | Deg. | * | | * | * | * | | * |
| NB_TMP | 17 | Number of temperatures | / | | | | | | | * |
| PRECIP01 | 21 | Precipitations in 1 hr. | mm | | * | * | | | * | * |
| PRECIP02 | 22 | Precip. in 2 hours | mm | | * | * | | | * | * |
| PRECIP03 | 23 | Precip. in 3 hours | mm | | * | * | | | * | * |
| PRECIP06 | 24 | Precip. in 6 hours | mm | | * | * | | | * | * |
| PRECIP09 | 25 | Precip. in 9 hours | mm | | * | * | | | | * |
| PRECIP12 | 26 | Precip. in 12 hours | mm | | * | * | | | * | * |
| PRECIP15 | 27 | Precip. in 15 hours | mm | | * | * | | | | * |
| PRECIP18 | 28 | Precip. in 18 hours | mm | | * | * | | | | * |
| PRECIP24 | 29 | Precip. in 24 hours | mm | | * | * | | | * | * |
| SNOW_DEPTH | 45 | Depth of Snow Layer | cm | | * | | | | | * |
| SNOW_ICE | 49 | Layer of snow on ice depth | cm | | | | | | * | * |
| SNOW_WAT24 | 47 | Snow in 24h Wat Equiv | mm | | | | | | * | * |
| SNOW_WATER | 46 | Snow Layer Wat Equiv | mm | | | | | | * | * |
| STAGE | 43 | Stage hydro. station. | cm | | | | | | * | * |
| TIDE_GAUGE | | Sea Level | m | | | | | | | * |
| WA_HT | 8 | Wave height | m | * | * | * | | | | * |
| WA_PE | 7 | Wave period | s | * | * | * | | | | * |
| WIWA_HT | 36 | Wind wave height | m | | * | * | | | | * |
| WIWA_PE | 35 | Wind wave period | s | | * | * | | | | * |
| WI_DI | 15 | Wind direction | Deg | * | * | * | * | * | | * |
| WI_GU | 56 | Wind gust at the obs. | m/s | | * | * | | | | * |
| WI_GU01 | 51 | Wind gust in prev. hour | m/s | | * | * | | | | * |
| WI_GU03 | 52 | Wind gust in prev. 3 hours | m/s | | * | * | | | | * |
| WI_SP | 1 | Wind Speed | m/s | * | * | * | * | * | | * |
| WT_SA, l<0 | 9 | Water Salinity | psu | * | | | | * | | * |
| WT_SA, l=0 | 9 | Mixed Layer Salinity | psu | * | | | | * | | * |
| WT_T, l<0 | 6 | Water Temperature (probe) | C | * | | | * | * | | * |
| WT_T, l=0 | 6 | SST (hull contact) | C | * | * | * | * | * | * | * |
| WT_T_BUCK | 54 | Water temp. (bucket) | C | | * | * | | | | * |
| WT_T_INTK | 53 | Water temp. (intake) | C | | * | * | | | | * |
| WT_T_OTHER | 55 | Water temp. other than T,T-INTK,T-BUCK | C | * | * | | | | * | |
| _SE#01 | 65537 | Sensor number 1 | / | | | | | | | * |

Comments on Table 1

1: "l=0" means measurement at sea surface, and "l<0" means measurement below surface.

2: If an Air Pressure Tendency (AI_PT, always positive) sensor is used, it should be in conjunction with a Characteristic of Pressure Tendency (AI_PTC) sensor (see group **appp** in Annex C.1, C.2, and C.3). If no Characteristic of Pressure Tendency sensor is used, then an Air Pressure Variation Sensor (AI_PV) should be used instead (positive or negative).

3: BUOY code replaced DRIFTER in November 1994. BUFR is not available at the time of writing (June 2000).

## 5.7 - Reporting observation time

Most measurements are averaged over a few minutes, just before being encoded into the Argos message, then sent to the satellite every 90 seconds or so until another set of averaged data is available. The default observation time, also sometimes called measurement time, is when the satellite collects the message (satellite time). However the GTS sub-system also offers other options, described below.

The Argos GTS sub-system computes the observation time for each sensor according to the algorithm below (terms described in § 5.7.1 to 5.7.15). Different sensors can be initialized differently:

```
If WAAP_Correction Then
   If [Timer Val1] Modulo WAAP_MODULO = 0 Then
      Time is not valid
      [UTC Time]:= NIL
      Exit
   Else
      If WAAP_TEST_VALUE<>0 Then
         If [Timer Val1] < WAAP_TEST_VALUE Then
            [Computed Time]:= [Timer Val1]*[N] + WAAP_OFFSET*60
         Else
            [Computed Time]:= [Timer Val1]*[N]
         Endif
      Else
         [Computed Time]:= ([Timer Val1] Modulo WAAP_MODULO)*[N]
      Endif
   Endif
Else
   If timer in the form of Date/Time then
      [Computed Time]:= [Date/Time Value]
   Else
      [Computed Time]:= [Timer Val1]*[N] + [Timer Val2]*[M]
   Endif
Endif

[UTC Time]:= [Reference Time] + [A]*[Computed Time]

If [Special Correction]="Offset After Correction" Then
   If [UTC Time]>[Data collection time] Then
      [UTC Time]:= [UTC Time] - [Reference Period]
   Endif
Endif

[UTC Time]:= [UTC Time] + [Offset]

If [Special Correction]="Offset Before Correction" Then
   If [UTC Time]>[Data collection time] Then
      [UTC Time]:= [UTC Time] - [Reference Period]
   Endif
Endif
```

If you wish, [UTC Time] can then be rounded to the nearest hour, minute or second, etc. according to the following code:

| **Code** | **Rounding times to the nearest** |
|---|---|
| 0 | Not rounded |
| 1 | Second |
| 2 | Minute |
| 3 | Hour |
| 4 | 3 hours |
| 5 | 30 minutes |
| 6 | 15 minutes |
| 7 | 10 minutes |
| 8 | 5 minutes |

### 5.7.1 - [UTC Time]

The final observation time sent onto the GTS.

### 5.7.2 - [Special Correction]

Values can be:

| | |
|---|---|
| "N" | No Special Correction |
| "A" | Offset After Correction |
| "B" | Offset Before Correction |

### 5.7.3 - [Data collection time]

Time at which platform sends Argos message to satellite.

### 5.7.4 - [Reference Time]

Baseline for assigning a time to your observations. Each sensor can have a different reference time, as defined using one of the following codes:

| Algorithm | Reference Time | Example | |
|---|---|---|---|
| | | Data collection time | Reference time |
| 0 | Specific date submitted by PI | | |
| 1 | Jan. 1 of current year (year in which data was collected) | 08:57:03 on Aug. 12, 2001 | 00:00:00 on Jan.1, 2001 |
| 2 | First day in current month (month in which data was collected) | 08:57:03 on Aug. 12, 2001 | 00:00:00 on Aug.1, 2001 |
| 3 | Exact data collection time | 08:57:03 on Aug. 12, 2001 | 08:57:03 on Aug.12, 2001 |
| 4 | Data collection time rounded to hour immediately below | 08:57:03 on Aug. 12, 2001 | 08:00:00 on Aug.12, 2001 |
| 5 | Data collection time rounded to closest hour | 08:57:03 on Aug. 12, 2001 | 09:00:00 on Aug.12, 2001 |
| 6 | Data collection time rounded to synoptic time (00:00:00, 03:00:00, 06:00:00, etc.) immediately below | 08:57:03 on Aug. 12, 2001 | 06:00:00 on Aug.12, 2001 |
| 7 | Data collection time rounded to closest synoptic hour | 08:57:03 on Aug. 12, 2001 | 09:00:00 on Aug.12, 2001 |
| 8 | 00:00:00 UTC on data collection day | 08:57:03 on Aug. 12, 2001 | 00:00:00 on Aug.12, 2001 |
| 9 | 00:00 solar time on data collection day, i.e. depends on platform longitude:<br>e.g. 90° East<br>e.g. 90° West<br>e.g. 165° East | 14:09:43 on Aug. 12 2001 | 18:00:00 on Aug. 11, 2001<br>06:00:00 on Aug. 12, 2001<br>11:00:00 on Aug. 12, 2001 |
| 10 | 00:00 UTC or 12:00 on data collection day (immediately prior to data collection) | 18:57:03 on Aug. 12, 2001 | 12:00:00 on Aug. 12, 2001 |
| 11 | Time of last message in satellite pass that collected the message | 08:57:03 on Aug. 12, 2001 | 09:12:27 on Aug. 12, 2001 (satellite pass time) |
| 12 | Multiple of N minutes preceding data collection time. PI provides. E.g. n=20: | 08:57:03 on Aug. 12, 2001 | 08:40:00 on Aug. 12, 2001 |
| 13 | No reference time if a Time sensor provides it. | | |
| 14 | Uses as observation time a previous observation time when one exists for the same platform in the period [satellite pass time - N minutes] to [Satellite pass]. If such a time was not found then [satellite pass] time is used as observation time. Value of N is given by the user for every sensor. | 08:57:03 on Aug. 12, 2001 | 02:12:22 on Aug. 12, 2001 (because this obs. Time was found in database in the last 12 hours (e.g. N=720)) |

### 5.7.5 - [Reference Period]

[Reference Period] depends upon [Reference Time] as follows:

| Code | [Reference Period] |
| --- | --- |
| 4: | 1 hour |
| 6: | 3 hours |
| 8: | 24 hours |
| 9: | 24 hours |
| 10: | 12 hours |
| 12: | N minutes as defined by PI for [Reference Time] |
| other: | 0. |

### 5.7.6 - Coefficient [A]

Define [A] (+1 or -1) for the associated "Time sensor", if any.

### 5.7.7 - [Offset]

Constant, in minutes. Each sensor on each platform can have a different offset, in accordance with your requirements.

### 5.7.8 - [Computed Time]

Value of "Time sensor", if any. If there is no "Time sensor" [Computed Time] is forced to 0. Time sensors can be dedicated to any sensor on any platform.

[Computed Time] can be coded into the Argos message as [Date] and/or [Time] word(s). [Date] and [Time] words can be encoded in the following binary formats provided that all elements of a given date and/or time have the same binary format:

- Pure binary
- Two's complement binary
- Signed binary
- BCD

Each binary word can be binary permuted. See paragraph 5.2 for details regarding binary formats.

[Date] and/or [Time] word(s) can be defined as follows:

(1) Define [Date] by either of the following options:

- **Julian day**
- **Year** or **Year in Millennium** or **Year in Century** or **Year in Decade** and either
  - **Calendar day in year** or
  - **Month and Day in month**

(2) Define [Time] by either of the following options:

- **Number of N-second periods** (please provide N). Time is coded as $P_1$ x N
- **Number of N-second periods plus number of M-second periods** (provide N and M) Time is coded as ($P_1$ x N) + ($P_2$ x M)
- **Hour, Minutes** and **Seconds**
- **Hour** and **Minutes**
- **Hour**

Note: with the WAAP algorithm, introduced for NOAA's National Data Buoy Center WAAP type buoys, only timers in the form of **Number of N-second periods** are used for [Computed Time].

### 5.7.9 - [Date/Time Value]

Value of time sensor expressed as Date and/or Time. You must provide values of the bit positions and number of bits for the Date and/or Time components in the Argos message.

### 5.7.10 - [Timer Val1]

Raw value of timer expressed as **Number of N-second periods**. You must provide the value of **[N]** and the bit positions and number of bits for the timer value in the Argos message.

### 5.7.11 - [Timer Val2]

Raw value of second timer (i.e. **Number of M-second periods**) when an N-second and M-second period are used. You must provide the value of **[N]** and **[M]** and the bit positions and number of bits for the timer values in the Argos message.

### 5.7.12 - WAAP_correction

'Y' or 'N'. Says whether WAAP algorithm should be used or not. Defined in conjunction with the time sensor.

### 5.7.13 - WAAP_modulo

Modulo value defined in conjunction with time sensor if WAAP algorithm is used.

### 5.7.14 - WAAP_test value

Test value defined in conjunction with time sensor if WAAP algorithm is used.

### 5.7.15 - WAAP_offset

Offset value defined in conjunction with time sensor if WAAP algorithm is used.

## 5.8 - Message multiplexing

If you have too much data for a single 256-bit Argos message, you can spread observations across several messages, i.e. multiplex the data.

The multiplexing method you use must be compatible with the standard method used for the GTS sub-system. This is based on the method used by ATLAS TOGA-TAO Array moored buoys in the equatorial Pacific Ocean.

The different Argos messages can be coded using different formats. For example a platform could transmit surface data using format #1, then sub-surface data using format #2, etc. However, the data from messages in different formats and the information needed to identify the format must be independent of other messages.

Consider a set of Argos messages during a given satellite pass. As a first step, for each compressed Argos message, the system tries to identify the message format from the list you defined for that platform. Once it identifies the format, it processes the messages as if they were non-multiplexed. If it does not identify a format, it assumes a transmission error and flags this in the GTS database.

The message lengths may be different (e.g. format #1: 32 bits, format #2: 256 bits). They are assumed to be independent so that the data can be processed even if a transmission error occurs in another message, containing the same observation but in a different format.

For a given format define which of the following options you require to identify the format:

(1) $A*X + B*Y + C > 0$
(2) $A*X + B*Y + C = 0$
(3) $A*X + B*Y + C \# 0$

where:

X and Y are two summation values (logical bit-by-bit 'xor' summation or arithmetic '+' summation modulo M) of contiguous data words from the Argos message, e.g. N words of n bits starting from position P,

A, B, C are figures you provide:
C is an integer.
For arithmetic summation: A and B are integers.
For logical summation: A and B can only be 0, 1 or -1.

You must therefore provide:

• Number of different formats used for each platform (1 if messages are not multiplexed).

• For each format:

- format number,
- number of bits in platform message for that format,
- how to recognize format: option (1), (2) or (3),
- summation operator (logical 'xor' or arithmetic '+'),
- modulo value (M) if arithmetic summation is used,
- definition of X as a summation: state N, n and P,
- definition of Y as a summation: state N, n and P,
- values of A, B and C.

## 5.9 - Processing blocks (e.g. sub-surface floats)

Blocks are contiguous blocks of sensor values which are repeated in the Argos message. Although only 64 sensors can be defined for each PTT in the data-base of the GTS sub-system, using blocks it is possible to process more than 64 sensor values within an Argos message.

For example, depth (Z), temperature (T), and salinity (S) values can be repated in the Argos message to code a number of (Z,T,S) data points (i.e. a T/S profile). If all temperature sensors have the same declaration, except for the bits, blocks permit to only declare one T sensor in the GTS sub-system data base (technical files).

GTS sub-system can basically process 120 points of 4 sensors that way. Following rules apply:

- A block can contain up to 10 sensors knowing that memory allocated for blocks is allocated for 120 points of 4 sensors.
- A block only contains geo-phyical sensors (i.e. no timers, no checksums). If timers or checksums are used, they must be declared outside a block.
- A block can be defined as static (number of points is constant and must be provided) or dynamic (number of points is encoded in the Argos message). If block is dynamic, number of points can be encoded in the Argos message in Pure binary, two's complement, signed binary, or BCD (see paragraph 5.2)
- All sensor data from a block (plus block size, if any) belong to the same Argos message.
- Bit positions are given with reference to the first bit of the first data point of the block (other sensors refer to the first bit of Argos message). By convention, first bit of first data point of the block has position 0.

- A sensor within a block can have compensating sensors, outside or inside the block but not from another block. By convention, if compensating sensor is declared as "itself", then the value of the compensating sensor being considered when processing the data will be the value of the considered sensor when processing the previous data point. Otherwise, if compensating sensor is another sensor from the block, then the value considered will be the value of the considered sensor when processing the current data point.
- All sensors within a block must have an associated level sensor which can be "itself" (e.g. sensor Depth would have itself for level sensor).

# 6 - Location

When an observation is compted by the systrem, a location must be associated to it. Since buoys or stations are capable of recording observations onboard and later transmitting the data through the satellites, there is not necessarily a location available for a given time of observation. The system therefore looks for the closest (in time) location available in the data base for the considered platform and associates that location to the observation.

It is also possible to ask the system to find two close locations and to make an interpolation (or extrapolation) in order to have an estimated location at the exact time of observations. This method is only effective for platforms with relatively straight trajectories such as ships.

Certains platforms are equipped with GPS receivers. GTS sub-system can decode latitudes, longitudes, time of location and use this information for the location.

For buoys, Argos location class is encoded in BUOY reports.

# 7 - Quality control

The GTS sub-system does automatic Quality Control to prevent bad data going onto the GTS. You can select different tests for different sensors. They include:

## 7.1 - Gross Error Check

For each kind of geophysical variable, sensor data are compared with constant limits. Out-of-range data are not sent onto the GTS.

## 7.2 - User Limit check

Each sensor measurement is compared with limits you provide. Each sensor can have its own limits. Out-of-range data are not sent onto the GTS.

## 7.3 - Compression Index, Checksum

**Sensor data for which the Compression Index by Sensor (CIS) is lower than a minimum acceptable value (entered for each individual platform sensor, usually 2) are automatically rejected from GTS distribution, unless a checksum sensor returns 'OK'.**

### 7.3.1 - Compression index

Compression means grouping identical values from a given satellite pass and platform.

*7.3.1.1 - Compression by message*

Identical Argos messages from a given satellite pass and platform are grouped together. The number of identical Argos messages received during the same satellite pass is called the Compression Index by Message (CIM). You can choose between the following options:

(1) Keep the message with the highest compression index. CIS as described in § 7.3.1.2 is forced to the value of CIM.

or

(2) Keep all the messages so that full sensor compression can be applied (see § 7.3.1.2).

*7.3.1.2 - Compression by sensor*

Identical sensor measurements from all messages collected in a given satellite pass from the same platform are grouped together, provided the sensor is in the same position in the Argos message, the sensor level is the same, and the computed observation time the same. The number of identical sensor measurements is called the Compression Index by Sensor (CIS). The sensor measurements with the highest CIS are stored and sent onto the GTS.

### 7.3.2 - Checksums

Checksum "sensors" validate the transmission link between the platform, the satellite and the ground station. A bad checksum usually indicates that one or more bits in a string of contiguous bits from the Argos message is bad.

The platform computes the sum of some of the words in the message and encodes it into the message. When the GTS sub-system receives and processes the messages, it recalculates the sum and compares it with the sum in the platform message. If the sums don't match, the part of the message in which the sum was computed is rejected: there were apparently one or more bit errors during transmission. The system does not send the data onto the GTS.

Note: If the checksum is unavailable or if the platform's message format does not provide one, the GTS sub-system only sends the data onto the GTS if it receives at least two identical messages.

The PTT message contains the value (MC) of a checksum computed on-board, and then recalculated by the system (CC) for comparison. In order to be considered as correct, a checksum from the message must agree with the following formula:

Classical checksum: (K1*CC + K2*MC + K3) modulo M = 0
CC ("Computed Checksum") is the summation of contiguous data words of the same length.

Hamming codes: (CC + K1*MC + K3) modulo M = 0
CC ("Computed Checksum") is computed according to Hamming algorithm which uses a constant polynom value.
K2 is the number of zero bits to add at the end of the bit stream before starting computation.

Webb checksum: (K1*CC + K2*MC + K3) modulo M = 0

CC ("Computed Checksum")is computed according to Webb algorithm which uses a constant polynom value.

Where:

CC is "Computed Checksum" (computed by system),

MC is "Message Checksum" (computed by platform and encoded into message),

K1, K2 and K3 are constants,

M is a constant modulo value.

Summation can be either an arithmetic "+" or a logical "xor" exclusive or "bit by bit" summation (i.e. parity, in which case no Modulo operation is done). It means N contiguous data words of n bits starting at position P in the Argos message.

Information to provide:

- name of algorithm to use (Default, Hamming, Webb)
- summation operator (logical 'xor' or arithmetic '+'),
- Modulo value (M) if arithmetic summation is used (convention: if M=0 then no Modulo operation is done),
- definition of MC as a data word from the Argos message, i.e. first bit position and number of bits,
- definition of CC as a summation of data words from the Argos message (i.e. values of N, n and P),
- values of integer constants K1, K2 and K3.
- Value of the polynom, a 32 bit number which value is provided in hexadecimal.

## 7.4 - Level rejected by QC

If a level sensor (stating the depth at which a main sensor makes measurements) is is rejected by QC, then the main sensor is also rejected.

## 7.5 - All bits identical test

If requested, data can be automatically removed from GTS distribution if all the bits in the sensor word are ones or zeros.

## 7.6 - Sensor blockage test

If the reported sensor data are always identical during a user-definable period or number of identical values, then data will be automatically removed from GTS distribution.

## 7.7 - Bad associated compensating sensor

Main sensor value is rejected if the compensation sensor (or 2nd compensating sensor) was rejected by the QC tests.

## 7.8 - Same value transmitted X minutes before

Sensor value (measured at H) is rejected if the same sensor value observed at H minus X minutes has already be distributed on GTS. Value of X is given by the user for each sensor. X corresponds to the value of [Reference period] as detailed in paragrpah 5.7.5.

## 7.9 - Managing duplicate times of observation

Because of the nature of the Argos system and the way data are processed, GTS sub-system can produce duplicates, and quasi duplicates (very close observation times). To deal with this problem, several solutions are offered:

- Rounding times of observation (See paragraph 5.7)
- Setting a duplicate tolerance, a number of seconds. If two observations for one PTT are within indicated value for "duplicate tolerance", then only the first processed observation is distributed on GTS. By default, duplicate tolerance is set to zero which means that all observations are accepted.

# 8 - GTS distribution

## 8.1 -Deferred GTS distribution

System is capable of deferred GTS distribution. By default, GTS reports are sent immediately. Deferred time GTS distribution can be useful when:

- User can easily accepts additional delays (e.g. sub-surface oceanographic data)
- All neccessary information to compile an observation is obtained through several satellite passes.

## 8.2- GTS Bulletins

Validated sensor data from platforms and satellite passes are grouped if their observation times are identical. The WMO Identification Number, Location, Time of Observation, and sensor data set is called an "observation". An observation coded into a GTS code form is called a GTS Report.

Observations are sent onto the GTS using requested GTS code forms on the following basis:

Recommended:

One observation ==> One GTS message if only one GTS code is requested,

or as follows (not recommended):

One observation ==> As many GTS messages as GTS codes requested (e.g. BATHY and SHIP).

or as follows (not recommended):

One observation ==> For each geophysical variable, as many GTS messages as GTS codes requested (e.g. Air Pressure distributed in SHIP format, Sub-Surface Temperatures distributed in BATHY and TESAC).

GTS Reports are grouped according to whether their GTS code forms are identical and, depending on the GTS code form, additional criteria such as identical observation time and area of deployment. A set of grouped GTS Reports using a single GTS code form is called a GTS bulletin. Bulletins are distributed onto the GTS.

Table 2: **$A_1A_2$** for GTS bulletin Headers of SYNOP and HYDRA reports (from Table C1, Part II of WMO Manual on the Global Telecommunication System, Volume I, Global Aspects, WMO No 386):

**Table 2, part I: Countries or territories**

| | | |
|---|---|---|
| AB Albania | AG Argentina | AH Afghanistan |
| AI Ascension Island | AK Alaska | AL Algeria |
| AN Angola | AT Antigua, St. Kitts and other British islands in the vicinity | |
| AU Australia | AZ Azores | BA Bahamas |
| BC Botswana | BD Brunei Darussalam | BE Bermuda |
| BH Belize | BI Burundi | BJ Benin |
| BK Banks Islands | BM Myanmar | BN Barhain |
| BO Bolivia | BQ Baltic Sea Area | BR Barbados |
| BU Bulgaria | BV Bouvet Island | BW Bangladesh |
| BX Belgium, Luxembourg | BY Belarus | BZ Brazil |
| CA Caribbean area and Central America | | CD Chad |
| CE Central African Republic | CG Congo | CH Chile |
| CI China | CM Cameroon | CN Canada |
| CO Colombia | CR Spain (Canary Islands) | CS Costa Rica |
| CT Canton Island | CU Cuba | CV Cape Vert |
| CY Cyprus | CZ Czechoslovakia | DJ Djibouti |
| DL Germany | DN Denmark | DO Dominica |
| DR Dominican Republic | EG Egypt | EQ Ecuador |
| ER United Arab Emirates | ES El Salvador | ET Ethiopia |
| FA Faeroes | FG French Guiana | FI Finland |
| FJ Fiji | FK Falklands (Malvinas) | FP St. Pierre et Miquelon |
| FR France | FW Wallis and Futuna Islands | |
| GB Gambia | GC Cayman Islands | GD Grenada |
| GE Gough Island | GH Ghana | GI Gibraltar |
| GL Greenland | GM Guam | GN Guinea |
| GO Gabon | GQ Equatorial Guinea | GR Greece |
| GU Guatemala | GW Guinea-Bissau | GY Guyana |
| HA Haiti | HE St. Helena | HK Hong Kong |
| HO Honduras | HU Hungary | HV Burkina Faso |
| HW Hawaiian Islands | IC Comoros | ID Indonesia |
| IE Ireland | IL Iceland | IN India |
| IQ Iraq | IR Iran, Islamic Republic of | IS Israel |
| IV Cote d'Ivoire | IY Italy | JD Jordan |
| JM Jamaica | JP Japan | KA Caroline Islands |
| KB Kiribati | KI Christmas Island | KK Cocos Islands |
| KN Kenya | KO Korea, Republic of | KP Cambodia |
| KR Democratic People's Republic of Korea | | KU Cook Islands |
| KW Kuwait | LA Lao People's Democratic Republic | |
| LB Lebanon | LC Saint Lucia | LI Liberia |
| LN southern Line Islands | LS Lesotho | LU Aleutian Islands |
| LY Libyan Arab Jamahiriya | MA Mauritius | MB Marion Island |
| MC Morocco | MD Madeira | |
| MF Saint-Martin, Saint-Bartholomew, Guadeloupe and other French islands in the vicinity | | |

| | | |
|---|---|---|
| MG Madagascar | MH Marshall Islands | MI Mali |
| MK Macquarie Island | ML Malta | |
| MN St. Maarten, St. Eustasius and Saba | | MO Mongolia |
| MR Martinique | MS Malaysia | MT Mauritania |
| MU Macao | MV Maldives | MW Malawi |
| MX Mexico | MY Mariana Islands | MZ Mozambique |
| NC New Caledonia | NF Norfolk Island | NG Papua New Guinea |
| NI Nigeria | NK Nicaragua | NL Netherlands |
| NM Namibia | NO Norway | NP Nepal |
| NR Niger | NU Netherlands Antilles (Aruba, Bonaire, Curacao) | |
| NV Vanuatu | NW Nauru | |
| NZ New Zealand | OM Oman | OR South Orkney Islands |
| OS Austria | PF French Polynesia | PH Philippines |
| PI Phoenix Islands | PK Pakistan | PL Poland |
| PM Panama | PO Portugal | PR Peru |
| PT Pitcairn Island | PU Puerto Rico | PY Paraguay |
| QT Qatar | RA Russian Federation (Asia) | |
| RE Reunion and associated islands | | RO Romania |
| RS Russian Federation (Europe) | | RW Rwanda |
| SB Sri Lanka | SC Seychelles | SD Saudi Arabia |
| SG Senegal | SI Somalia | SK Sarawak |
| SL Sierra Leone | SM Suriname | SN Sweden |
| SO Solomon Islands | SP Spain | SR Singapore |
| SU Sudan | SV Swaziland | SW Switzerland |
| SX Santa Cruz Islands | SY Syrian Arab Republic | SZ Spitzbergen |
| TC Tristan da Cunha | TD Trinidad and Tobago | TG Togo |
| TH Thailand | TI Turk Islands | TK Tokelau Islands |
| TM Timor | TN Tanzania, United Republic of | |
| TO Tonga | TP Sao Tome and Principe | TS Tunisia |
| TU Turkey | TV Tuvalu | UG Uganda |
| UK United Kingdom of Great Britain and Northern Ireland | | UR Ukrain |
| US United States of America | UY Uruguay | VI Virgin Islands |
| VN Venezuela | VS Viet Nam | WK Wake Island |
| YE Yemen | YG Yugoslavia | ZA South Africa |
| ZB Zambia | ZM Western Samoa | ZR Zaire |
| ZW Zimbabwe | | |

**Table 2, part II: Vast areas such as continents, hemispheres**

| | | |
|---|---|---|
| AA Antarctic | AC Arctic | AE South-East Asia |
| AF Africa | AM Central Africa | AO West Africa |
| AP Southern Africa | AR Arabian Sea area | AS Asia |
| AW Near East | EA East Africa | EC East China Sea area |
| EE Eastern Europe | EM Middle Europe | EN Northern Europe |
| EU Europe | EW Western Europe | FE Far East |
| GA Gulf of Alaska area | GX Gulf of Mexico area | IO Indian Ocean Area |
| ME Eastern Mediterranean area | | MM Mediterranean area |

| | | |
|---|---|---|
| MP Central Mediterranean area | | MQ Western Mediterranean |
| NA North America | NT North Atlantic area | OC Oceania |
| OH Sea of Okhotsk | PA Pacific area | PE Persian Gulf area |
| PN North Pacific area | PQ Western North Pacific | PS South Pacific area |
| PW Western Pacific area | PZ Eastern Pacific area | SA South America |
| SE Southern Ocean area | SJ Sea of Japan area | SS South China Sea area |
| ST South Atlantic area | XE Eastern Hemisphere | XN Northern Hemisphere |
| XS Southern Hemisphere | XT Tropical belt | XW Western hemisphere |

XX for use when other designators are not appropriate

## 8.3 - GTS bulletin headers

### 8.3.1 - General form

GTS bulletins are identified by headers to make sure they reach the right operational centres as detailed below. The general form for a GTS bulletin header is:

**$T_1T_2A_1A_2$ii CCCC YYGGgg [$RR_x$]**

Where:

| | |
|---|---|
| **$T_1T_2$** | Data Type Designator, |
| **$A_1A_2$** | Geographical Designator, |
| **ii** | Level or Deployment area, |
| **CCCC** | Originating Centre (LFPW=Toulouse, KARS=Largo), |
| **YYGGgg** | Time of bulletin: Day in the month (YY), Hour (GG) and Minutes (gg), |
| **$RR_x$** | For Delayed Routine Meteorological Reports (optional). |

li

The system automatically initiazes part of the bulletin header, i.e.
CCCC YYGGgg [$RR_x$] for all types of reports plus :

-$T_1T_2$ for BATHY, HYDRA, SHIP, SYNOP, TESAC reports

- $T_1T_2A_1A_2$ for BUOY reports

### 8.3.2 - Information you need to provide

BUOY Reports:

ii, depending on upon the Argos Processing Centre (Toulouse or Largo) and the deployment area. See tables 3 and 4 below:

**Table 3:** Data distributed from the US Argos Global Processing Centre, Largo, USA

| Bulletin header TTAAii CCCC | Deployment area | Remark |
|---|---|---|
| SSVX02 KARS | GDP | New |
| SSVX04 KARS | North Atlantic and EGOS | Same |
| SSVX06 KARS | Northern Hemisphere | Same |
| SSVX08 KARS | TAO, PIRATA | Was SSVX40 for TAO |
| SSVX10 KARS | Southern Hemisphere and ISABP | Same |
| SSVX12 KARS | Arctic, Antarctic, sea ice | Arctic, Antarctic merged |
| SSVX14 KARS | Indian Ocean and IBPIO | New |
| SSVX16 KARS | Navoceano | Same |

| | | |
|---|---|---|
| SSVX18 KARS | Pacific Ocean | New |
| SSVX20 KARS | Navoceano | Same |
| SSVX22 KARS | Mediterranean sea | New |
| SSVX42 KARS | NOAA/NDBC, Southern Hemisp | Was SSVX02 |
| SSVX44 KARS | NE Pacific Ocean (USA, and Car | Was SSVX18 |
| SSVX48 KARS | NOAA/NDBC, Northern Hemisp | Was SSVX08 |
| SSVX96 KARS | NDBC | Same |

**Table 4**: Data distributed from the French Argos Global Processing Centre, Toulouse, France

| Bulletin header TTAAii CCCC | Deployment area | Remark |
|---|---|---|
| SSVX01 LFPW | North Atlantic and EGOS | Same |
| SSVX03 LFPW | Southern Hemisphere and ISAB | Same |
| SSVX05 LFPW | Northern Hemisphere | Same |
| SSVX07 LFPW | Arctic, Antarctic, and sea ice | Arctic, Antarctic merg |
| SSVX09 LFPW | Indian Ocean and IBPIO | New |
| SSVX11 LFPW | TRITON | New |
| SSVX13 LFPW | GDP | New |
| SSVX15 LFPW | Pacific | New |
| SSVX21 LFPW | Mediterranean Sea | New |
| SSVX39 LFPW | French West Indies | Was SSVX19 |

SYNOP, HYDRA Reports:

**$A_1A_2$**, depending upon station deployment position
Refer to table 2.

ii, coded from 01 to 19, means these values are normally distributed to all weather centres worldwide.

SHIP, BATHY, TESAC Reports:

**$A_1A_2$** depends upon the type of station and the geographical area where the platform is reporting from:

**$A_1$**: W for Ocean Weather Stations
V for Mobile Ships and other Marine Stations

**$A_2$**: A area between 30N-60S, 35W-70E
B area between 90N-05N, 70E-180E
C area between 05N-60S, 120W-35W
D area between 90N-05N, 180W-35W
E area between 05N-60S, 70E-120W
F area between 90N-30N, 35W-70E
J area south of 60S
X more than one area

ii, generally coded from 01 to 19, means these values are normally distributed to all weather centres worldwide.

BUFR reports (not distributed yet).

# 9 - Direct distribution to Argos users

In addition to GTS distribution of the data, the Argos GTS sub-system is capable of distributing processed data directly to the Argos users. This can be done either only to an Argos user or both to an Argos user and to the GTS. This distribution mode can be useful for principal investogators to check that the data are being correctly decoded, processed and QC'ed by the system before effectively asking for GTS distribution of the data.

Data can be received by the users either in GTS format or in two specific formats called STD and SIMPLE.

## 9.1 -STD format

Each observation is coded as following (coded fields indicated in bold below are separated by commas):

**STD,Argos_ID,WMO,YYYYMMDDHHmm,**
**Latitude,Longitude,YYYYMMDDHHmm,QCLoc,Nb_Sensor**
Repeat Nb_Sensor times
    If Option=1 then
        **Sensor_name,Level,Sensor_value**
    Sinon
        **Sensor_type,Level,Sensor_value**
    Finsi

With:

| Field | Coding |
|---|---|
| STD | 3 characters coded "STD" |
| Argos_ID | 5 characters, Argos number |
| WMO | 7 characters, WMO number (first 7 digits) |
| YYYYMMDDHHm | 12 characters, observation date & time |
| Latitude | 8 characters, F8.4, Latitude |
| Longitude | 9 characters, F9.4, Longitude |
| YYYYMMDDHHm | 12 characters, date de la localisation |
| QCLoc | 2 characters, Localization class |
| Nb_Sensor | 2 characters, number of sensor values to follow for the observation |
| Sensor_name | 6 characters, sensor name as declared in the system (first 6 characters, e.g. SEATEMP) |
| Sensor_type | 6 characters, sensor type (first 6 characters, e.g. WT_T) |
| Level | 5 characters, probe level in meters (<0 for probes below sea surface) |

| | |
|---|---|
| Sensor_value | 8 characters, F8.3, sensor value |

Example:

Option 1 (sensor names):

```
STD,17193,XBTTEST,199909300500, 40.0000,  20.0000,19990930052955,03, 4
BUOY_N,    0,   6.000
WINDIR,    0, 170.385
WINDSP,    0,   2.000
AIRTEM,    0,  29.100
```

Option 2 (sensor types):

```
STD,20392,52083  ,200109192100,  7.9910, 156.0068,200109191826,03,18
AI_T  ,    0,  29.200
AI_P  ,    0,1009.500
AI_HUM,    0,  69.200
WT_T  ,    0,  29.820
WI_DI ,    0, 158.000
WI_SP ,    0,   1.000
WT_T  ,   -2,  29.820
WT_T  ,  -25,  29.750
WT_T  ,  -50,  29.050
WT_T  ,  -75,  27.750
WT_T  , -100,  25.240
WT_T  , -125,  23.330
WT_T  , -150,  18.020
WT_T  , -200,  13.480
WT_T  , -250,  10.600
WT_T  , -300,   9.700
WT_T  , -500,   7.770
WT_T  , -750,   5.760
AI_T  ,    0,  29.100
```

## 9.2 -SIMPLE format

Each observation is coded as following (coded fields indicated in bold below are separated by commas, records can have varying length):

**BEGIN**
**Argos_ID,WMO,YYYYMMDDHHmmss,Nb_Capt**
**Latitude,Longitude,YYYYMMDDHHmmss,QCLoc**
Repeat Nb_sensor times:
    **Sensor_name,Sensor_type,Level,Sensor_value,QC_Flags**
**END**

With:

| Field | Coding |
|---|---|
| BEGIN | 5 characters coded "BEGIN" |
| Argos_ID | 5 characters, Argos number |
| WMO | 5 to 7 characters, WMO number (first 7 digits) |
| YYYYMMDDHHmmss | 14 characters, observation date & time |
| Latitude | 8 characters, F8.4, Latitude |
| Longitude | 9 characters, F9.4, Longitude |
| YYYYMMDDHHmmss | 14 characters, date de la localisation |
| QCLoc | 2 characters, Localization class |
| Nb_Sensor | 2 characters, number of sensor values to follow for the observation |
| Sensor_name | 16 characters, sensor name as declared in the system (e.g. SEATEMP) |
| Sensor_type | 10 characters, sensor type (e.g. WT_T) |
| Level | 8 characters, F8.1, probe level in meters (<0 for probes below sea surface) |
| Sensor_value | 8 characters, F15.6, sensor value |
| QC_Flags | 6 characters, QC flag results, 1 character for each QC test (0=OK, 1=not tested, 2:dubious, 3=bad). 6 flags coded here. See list of QC tests in paragraph 7. |
| END | 3 characters coded "END" |

Example:

```
BEGIN
17193,PTFM1,20001120110400,02
 40.0000,  20.0000,20001120105917,03
AIRTEMP         ,AI_T      ,     0.0,       14.261176,000110
ATMPRES         ,AI_P      ,     0.0,     1011.291373,000110
END
```

# 10 - Automatic modification of GTS technical file via email

Argos GTS users can access (read or write) technical files of GTS platforms via Email. The system reads received messages on an hourly basis,processes the messages and replies to the users

## 10.1 - Read Access

Technical file access request is done via Email according to the following rules:

- User provides the Argos User Office with Email address he will use to send messages.This address is inserted into a list updated by the Argos User Office. This list permits to check identity of the user and to send results back to him.
- User sends one message per platform for which he wants to read GTS TechnicalFile.
- Based upon what Argos centre the platform belongs to, the message is sent to an Internet address in SAI (Largo, USA) or CLS (Toulouse, France):
- Toulouse: gts_tf@diane.cls.fr
- Largo: gts_tf@argosinc.com
- Subject line follows the syntax below:
    - To get technical file in SHORT format:
      **TF:READ; USER=UserName; PTT=Argos_ID**
    - To get technical file in LONG format:
      **TF:READ; USER=UserName;  PTT=Argos_ID; FORMAT=LONG**

As seen above, FORMAT keyword is optional. Its default value is SHORT (see examples of SHORT and LONG formats below).

Text of the message is free. It will not be processed by the system but will be archived.
The system recognises the UserName and the Internet origin of the message.It checks that the two match via the list of Email addresses maintainedby the User Office. If they don't the message is ignored and no error message is sent back to the originator (but one is sent to the Argos user). If they do match, Technical File data are read and returned to the user in less than 1 hour to the address given to theUser Office. If an error occures (e.g. syntax error in the subject line,or inexisting PTT numbers, or unauthorized access) then an error message is returned to the originator.

## 10.2 -Write access

Write access follows similar rules as above except for the following ones. Writing unit is still the platform. User sends a message per platform for which he wants to modify the GTS TechnicalFile.

Subject line follows the syntax below:

**TF:WRITE;USER=UserName**

Message text includes instructions for modification of a platform TechnicalFile according to the so called GTSMOD language (see example below for LONG format). Hence a user will be able to re-use a reading file (FORMAT=LONG), to modify it and to submit it via Email.
The system recognises the UserName and the Internet origin of the message.System checks email address as for the read option. If email addresses match, Technical File data are modified and confirmation returned to the user in less than 1 hour to the address given to the User Office. If an error occures (e.g. syntax error in theGTSMOD text submitted, or inexisting PTT numbers) then an error message is returned to the originator.
User must be aware that the operational system will not be able to take the modification into account before a delay of 1 minute to one hour.

## 10.3 - Security issues

Authentication

Authentication is realized through the email address of originating message.

Authorisation

For a given Argos Programme, the PrincipalGTS Co-ordinator (PGC) is the only person allowed by the Argos programme manager to make modifications to GTS technical files (manually via the User Office and remotely). However, a programme manager is not obliged to designate a PGC. In this case, only the programme manager himself plus authorised users will be in a position to do so. Users can be authorised to access to all programmes of a given programme manager, or to one or more programmes, or to one or more platforms of the programme manager.Above aspects of security are already taken into account in the GTS subsystem.

Access restriction

If a user has reservations regarding the level of security offered, he can ask that all of his platforms of all of his programmes be removed from remote access mode. For a programme, he can also forbid remote access or limit it to read access only. By default, remote reading as well as writing access is forbidden. A user will therefore have to explicitly ask for read or read/write access for each of his programmmes if he wants to use these facilities.

## 10.4 - Information to provide to the User Office

If a user wants to remotely access to his GTS Technical Files, he must:

- For each of his programmes, provide the User Office with either the name of the Principal GTS Coordinator (PGC) who will be authorised to access technicalfile data remotely, or with the list of users who will have authorisation.
- For each programme, for the designated PGC or for each authorised user, provide the User Office with the Email address he will use to access the system. The User Office will then provide the user with User Names for the PGC or authorised users.
- For each programme ask for read or read/write access.

# SHORT Format in read access

## Example:

GTS Technical file information for an Argos platform (SHORT)

```
PTT:18646 WMO=73502    GTS=N Program:01155 User:MORRISSY     DROGUE=N
CODE BUOY,  Bulletin Header = SSVX03

## SENSOR NAME      KIND       G LEVEL    A        B        PR POS BIT RF OFFST
01 HOUR             TIME
02 SEATEMP          WT_T       Y 0.00     1.000    0.000    B1  16 10   8     0
03 ATMPRES          AI_P       Y 1.00     1.000    0.000    B1   0 11   4     0
04 BATTERY          DEFAULT    Y 0.00     1.000    0.000    B1  26  6   4     0
05 AIRTEMP          AI_T       Y 0.00     1.000    0.000    B1  32 10   4     0
06 TENDCHAR         AI_PTC     Y 0.00     1.000    0.000    B1  42  6  11     0
07 TEND             AI_PT      Y 0.00     1.000    0.000    B1  48  8   4     0
08 HOUR_H-1         TIME
09 SEATEMP_H-1      WT_T       Y -1.00    1.000    0.000    B1  72 10   4   -60
10 ATMPRES_H-1      AI_P       Y 0.00     1.000    0.000    B1  56 11   4   -60
11 BATTERY_H-1      DEFAULT    Y 0.00     1.000    0.000    B1  82  6   4   -60
12 AIRTEMP_H-1      AI_T       Y 0.00     1.000    0.000    B1  88 10   4   -60
13 TENDCHAR_H-1     AI_PTC     Y 0.00     1.000    0.000    B1 104  6  11     0
14 TEND_H-1         AI_PT      Y 0.00     1.000    0.000    B1 104  8   4   -60
15 HOUR_H-2         TIME
16 ATMPRES_H-2      AI_P       Y 0.00     1.000    0.000    B1 112 11   4  -120
17 SEATEMP_H-2      WT_T       Y 0.00     1.000    0.000    B1 128 10   4  -120
18 BATTERY_H-2      DEFAULT    Y 0.00     1.000    0.000    B1 138  6   4  -120
19 AIRTEMP_H-2      AI_T       Y 0.00     1.000    0.000    B1 144 10   4  -120
20 TENDCHAR_H-2     AI_PTC     Y 0.00     1.000    0.000    B1 154  6  11     0
21 TEND_H-2         AI_PT      Y 0.00     1.000    0.000    B1 160  8   4  -120
22 HOUR_H-3         TIME
23 ATMPRES_H-3      AI_P       Y 0.00     1.000    0.000    B1 168 11   4  -180
24 SEATEMP_H-3      WT_T       Y 0.00     1.000    0.000    B1 184 10   4  -180
25 BATTERY_H-3      DEFAULT    Y 0.00     1.000    0.000    B1 194  6   4  -180
26 AIRTEMP_H-3      AI_T       Y 0.00     1.000    0.000    B1 200 10   4  -180
27 TENDCHAR_H-3     AI_PTC     Y 0.00     1.000    0.000    B1 210  6  11     0
28 TEND_H-3         AI_PT      Y 0.00     1.000    0.000    B1 216  8   4  -180
```

## Columns:

| | |
|---|---|
| ## | Sensor order in the declaration |
| SENSOR NAME | Sensor name |
| KIND | Type of geo-physical measurementG |
| GTS | distribution on/off for the sensor |
| LEVEL | Hight/Depth of probe |
| A | Coefficient A for linear correction (Y=A*Y+B) |
| B | Coefficient B for linear correction (Y=A*Y+B) |
| PR | Processing type for the calibration curve |
| POS | Bit position in the Argos essage (first message bit = 0) |
| BIT | Number of bits in the Argos message |
| RF | Reference time used for computation of observation time |
| OFFST | Time offset for computation of observation time |

## LONG format (compatible with GTSMOD language)

Example:

```
This program is to read calibration information from the GTS
Data Base for a given PTT and  to convert  this  information
into  a  file  using  the CALIBRATION compiler instructions.
PTT:22121
WMO=55574
! Program=00476 User=HICKMAN
GTS=Y
DROGUE=N
DEPLOYMENT= -36.000, 161.200
ALTITUDE=          0
! CODE BUOY Header code =SSVX    Header PTT=03
SENSOR  ATMPRES
   ! Sensor kind:AI_P
   DISSEM=Y
   LEVEL= 0.0000000000E+00
   TIME_OFFSET=          0
   ! Linear Correction: a= 0.1000000000E+01, b= 0.0000000000E+00
   LIMITS= 0.9010000000E+03, 0.1050000000E+04
   CALIBRATION_TYPE B1
         0: 0.9000000000E+03
      1023: 0.1053449951E+04
SENSOR  SEATEMP
   ! Sensor kind:WT_T
   DISSEM=Y
   LEVEL= 0.0000000000E+00
   TIME_OFFSET=          0
   ! Linear Correction: a= 0.1000000000E+01, b= 0.0000000000E+00
   LIMITS=-0.3000000000E+01, 0.3490000153E+02
   CALIBRATION_TYPE B1
         0:-0.3250000000E+01
       255: 0.3500000000E+02
SENSOR  ATMPRES_H-1
   ! Sensor kind:AI_P
   DISSEM=Y
   LEVEL= 0.0000000000E+00
   TIME_OFFSET=          0
   ! Linear Correction: a= 0.1000000000E+01, b= 0.0000000000E+00
   LIMITS= 0.9010000000E+03, 0.1050000000E+04
   CALIBRATION_TYPE B1
         0: 0.9000000000E+03
      1023: 0.1053449951E+04
```

# Annex A - Allocation of WMO numbers to Argos platforms

When data from Argos platforms are intended for transmission through the GTS, an identifier called the WMO identification number or WMO number is used in place of the Argos identifier. This provides stations with identifying numbers similar to the station index numbers assigned to land meteorological stations for operational, storage and retrieval purposes at national Meteorological Centres.

The WMO identification number is allocated depending upon which GTS code form is used, the type of the platform, and its deployment position.

**BUOY**: $A_1 b_w n_b n_b n_b$, (commonly called "WMO numner")

| | |
|---|---|
| $A_1$ | WMO Regional Association area in which platform is deployed (see figure 3) |
| $b_w$ | Sub area belonging to area $A_1$ (see figure 3). Note that sub-surface floats are allocated value 9 for $b_w$ |
| $n_b n_b n_b$ | Buoy type and serial number. 500 is added to the original value of this number to indicate a drifting buoy. The number is left as is for moored buoys. Hence in distributed GTS reports, it is always between 0 and 499 for moored buoys, and between 500 and 999 for drifting buoys. |

**BATHY, TESAC, SHIP**: $A_1 b_w n_b n_b n_b$ ("WMO number") or
D....D ("Ship's Call Sign"):

| | |
|---|---|
| $A_1$ | WMO Regional Association area in which the platform is deployed (see figure 3) |
| $b_w$ | Sub area belonging to area $A_1$ (see figure 3) |
| $n_b n_b n_b$ | Type and serial number of the platform |
| or | |
| D....D | Ship's Call Sign |

**Platform identifier in TESAC for profiling floats**

Observational data from profiling sub-surface floats deployed under Argo and similar projects are distributed on the GTS in TESAC code. The Data Buoy Cooperation Panel (DBCP) has developed an extension of the existing buoy identifier system to facilitate easy identification of the reports from these floats, as well as retain a unique ID number for all floats deployed (without recycling). The new identifier is to be **used in place of the ship's call sign, D….D, not the buoy identifier**. It extends the existing buoy ID structure from five to eight characters for floats, but retains the same format, with the addition of the letter Q as the first character:

$QA_1b_wn_bn_bn_bn_bn_b$

where:

Q = a letter not currently used as the first letter of a ship's call sign, to indicate that the report is from an Argo float
$A_1$ = WMO region of float deployment, with 7 used for the Southern Ocean south of 60°S
$b_w$ = 9 to signify a float
$n_bn_bn_bn_bn_b$ = a unique number for each float deployed in area $A_1$, allocated serially

This identifier is used in Section 5 of TESAC only, when the report is from a profiling float, and **is used in place of the ship call sign D….D**, not the buoy identifier. The existing five-digit buoy identifier group will be retained for TESAC reports originating from drifting and moored surface buoys.

The seven-digit float identifier in TESAC was implemented for all floats deployed on and after 1 June 2001.

**SYNOP** IIiii (commonly called "WMO Station Index Number"):

| | |
|---|---|
| II | WMO block Number (see Volume A of WMO publication No. 9) |
| iii | Station Number within WMO block II. |

**HYDRA** $AC_i$ and $BBi_Hi_Hi_H$:

| | |
|---|---|
| A | WMO Regional Association area, |
| $C_i$ | Indicator for country of Hydrological Basin, |
| BB | Hydrological Basin in the WMO Region (See Vol. II of WMO Manual on Codes for the list of basins), |
| $i_Hi_Hi_H$ | National Hydrological Observing Station Identifier within the basin. |

***BUFR*** *Once BUFR is implemented, the type of identification number may differ depending on the type of platform, and may take the form of one of the identification number detailed above for BUOY, BATHY, TESAC, SYNOP, SHIP or HYDRA code forms.*

For the allocation of these identifiers, programme managers must receive:
- platform numbers from CLS/Service Argos,

- WMO numbers from their national Meteorological Service or from their National Focal Point for Drifting Buoy Programmes (NFP) for drifting or moored buoys (see Annex B.2 for the list of NFPs). NFPs in turn obtain national allocations of buoy identification numbers from the WMO Secretariat, which maintains a master list. The following rules only apply to buoys.

When submitting requests, the geographical positions and nature of platforms should be specified (the position of initial deployment for drifting buoys). Requests for WMO numbers can also be made via the Technical Coordinator of the Data Buoy Cooperation Panel (TC-DBCP). See Annex B for address and telephone number.

The symbolic form $A_1b_wn_bn_bn_b$ of the identifier is used in FM 13-X SHIP, FM 63-X Ext. BATHY, FM 64-IX TESAC, and FM 18-X BUOY. Specifications of symbolic letters are as follows:

| | |
|---|---|
| $A_1$ | WMO Regional Association area in which buoy has been deployed (see figure 3).<br>1: Region I, Africa<br>2: Region II, Asia<br>3: Region III, South America<br>4: Region IV, North and Central America<br>5: Region V, South-West Pacific<br>6: Region VI, Europe<br>7: Antarctic |
| $b_w$ | Sub-area belonging to the area indicated by $A_1$ (see figure 3). |
| $n_bn_bn_b$ | Type and serial number of buoy. |

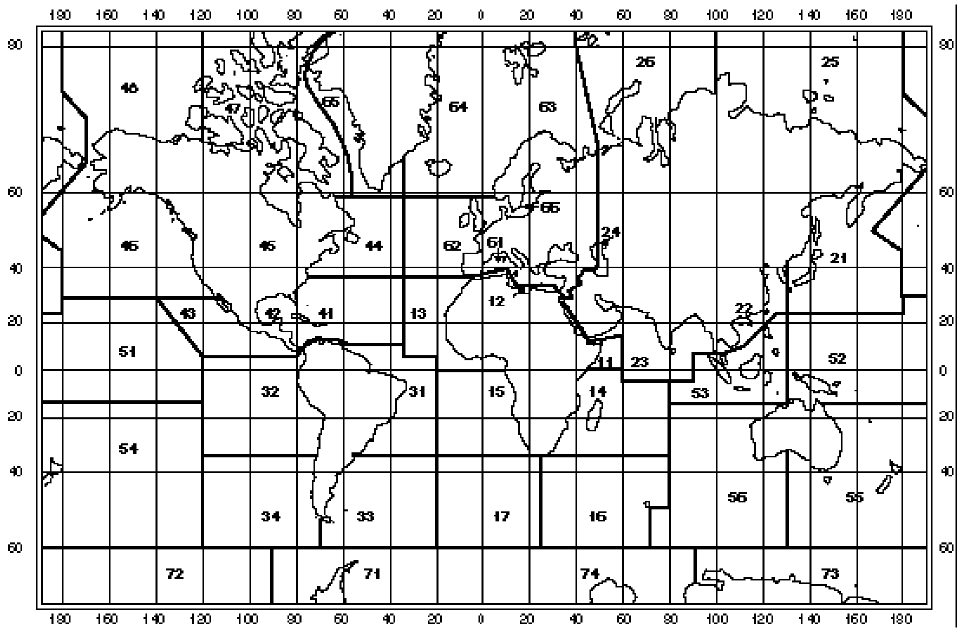
<u>Important</u>: Serial numbers for buoys in each maritime sub-area identified by $A_1$ and $b_w$ shall be allocated from the series 000 up to 499 but in the case of drifting buoys and other mobile platforms, 500 shall be added to the original $n_bn_bn_b$ number. A number allocated to a particular programme may effectively be used twice for that programme only, directly as allocated for a fixed platform and with the addition of 500 for a mobile platform. After the operational life-time of a given platform that reported onto the GTS, its WMO number may be re-used for another similar platform once, provided the rules above are still met, e.g. the platform is deployed in the same area. Non re-used WMO numbers may be released after 3 months of non-transmission.

Examples

14015 = No. 15 buoy, deployed in sub-area 4 in region I, stationary.
46673 = No. 173 buoy, deployed in sub-area 6 in region IV, drifting.

The identifier may be allocated to fixed as well as drifting buoy stations, mobile ship stations and, in some cases, land-based remote stations. Drifting buoys (and similarly other mobile platforms) retain the original identifier applicable to the WMO region and sub-area in which they were set adrift. As adopted by Recommendation 5 (CBS-Ext. (85)), stations at sea located on a drilling rig or oil-gas-production platform shall also carry an identifier number. In the case of such "semi-mobile" platforms, a new number will be required if the platform changes its geographical location from one area to another, e.g. from region III, South America, to region 1, Africa.

Figure 3: Chart of sea areas ($\mathbf{A_1 b_w}$) for use in assigning buoy identifiers. $\mathbf{A_1}$: WMO Regional Association area in which the buoy is deployed (1-Region I, 2-Region II, etc.). $\mathbf{b_w}$: Sub-area belonging to the area indicated by $\mathbf{A_1}$.



# Annex B - Addresses

## Annex B.1 - Argos User Offices

See addresses at http://www.cls.fr/html/cls/activite/adresses_en.html

## Annex B.2 - DBCP technical coordinator

See references at http://www.dbcp.noaa.gov/dbcp/1d.html#TC

## Annex B.3 - National Focal Points for drifting buoy programmes

See up to date list on the DBCP web site at : http://www.dbcp.noaa.gov/dbcp/1nfpfbp.html

# Annex C - GTS code forms in use with the Argos system

<u>Note</u>: This is neither an official description of WMO GTS code forms, nor a detailed one; it is rather written taking into consideration how these code forms can be generated from the Argos GTS sub-system. For formal WMO regulations and details, see the WMO Manual on Codes, Volume 1, International Codes, WMO N° 306. Particularly, groups not used with the Argos system do not appear in the code descriptions below.

In the following code descriptions,

- (i) Code fields are indicated in **bold**
- (ii) Optional fields are indicated in parentheses ()
- (iii) <u>Underlined</u> fields are constant fields or constant part of the message (e.g. <u>888</u>)
- (iv) Fields in brackets {} are exclusive

## C.1) BUOY code (WMO code form FM 18-XII BUOY)

Report of a drifting or moored buoy observation.
Replaced DRIFTER in November 1994.

Section 0 is mandatory, all other sections are optional.

| | | | | |
|---|---|---|---|---|
| Section 0: | $\underline{ZZYY}$ | $A_1b_wn_bn_bn_b$ | $YYMMJ$ | $GGggi_w$ |
| | | $Q_cL_aL_aL_aL_aL_a$ | $L_oL_oL_oL_oL_oL_o$ | $(\underline{6}Q_lQ_tQ_A\underline{/})$ |
| Section 1: | $\underline{111}Q_dQ_x$ | $\underline{0}ddff$ | $(\underline{1}s_nTTT)$ | |
| | | $\{(\underline{2}s_nT_dT_dT_d)$ or | $(\underline{29}UUU)\}$ | |
| | | $(\underline{3}P_oP_oP_oP_o)$ | $(\underline{4}PPPP)$ | $(\underline{5}appp)$ |
| Section 2: | $\underline{222}Q_dQ_x$ | $(\underline{0}S_nT_wT_wT_w)$ | $(\underline{1}P_{wa}P_{wa}H_{wa}H_{wa})$ | |
| | | $(\underline{20}P_{wa}P_{wa}P_{wa})$ | $(\underline{21}H_{wa}H_{wa}H_{wa})$ | |
| Section 3: | $\underline{333}Q_{d1}Q_{d2}$ | | | |
| | $\underline{8887}k_2$ | $(\underline{2}z_oz_oz_oz_o)$ | $(\underline{3}T_oT_oT_oT_o)$ | $(\underline{4}S_oS_oS_oS_o)$ |
| | | . . . . . . . | | |
| | | $(\underline{2}z_nz_nz_nz_n)$ | $(\underline{3}T_nT_nT_nT_n)$ | $(\underline{4}S_nS_nS_nS_n)$ |
| | $\underline{66}k_6\underline{9}k_3$ | $(\underline{2}z_oz_oz_oz_o)$ | $(d_od_oc_oc_oc_o)$ | |
| | | . . . . . . . | | |
| | | $(\underline{2}z_nz_nz_nz_n)$ | $(d_nd_nc_nc_nc_n)$ | |

| | | | | | |
|---|---|---|---|---|---|
| Section 4: | $\underline{444}$ | $(\underline{1}Q_pQ_2Q_{TW}Q_4)$ | $(\underline{2}Q_NQ_LQ_AQ_Z)$ | | |
| | | $\{(Q_cL_aL_aL_aL_aL_a$ | $L_oL_oL_oL_oL_oL_o)$ or $(YYMMJ\ GGgg\underline{/})\}$ | | |
| | | $(\underline{3}Z_hZ_hZ_hZ_h\ \underline{4}Z_cZ_cZ_cZ_c)$ | $(\underline{5}B_tB_tX_tX_t)$ | | |
| | | $(\underline{6}A_hA_hA_hA_N)$ | $(\underline{7}V_BV_Bd_Bd_B)$ | $(\underline{8}V_iV_iV_iV_i)$ | $(\underline{9/}Z_dZ_dZ_d)$ |

Brief description of the groups for BUOY:

| | |
|---|---|
| $A_1b_wn_bn_bn_b$ | WMO Identification number |
| $YYMMJ$ | Day in the month, Month, Year |
| $GGggi_w$ | Hour, Minutes, Indicator for wind units (1=m/s, 4=knots) |
| $Q_cL_aL_aL_aL_aL_a$ | Quadrant of the globe (1:NE,3:SE,5:SW,7:NW, Latitude (1/1000 degrees) |
| $L_oL_oL_oL_oL_oL_o$ | Longitude (1/1000 degrees) |
| $Q_l$ | Quality control indicator for the location fix. 0=not checked, 1=good, 2=inconsistent, 3=doubtful, 4=wrong, 5=data changed. |
| $Q_t$ | Quality control indicator for the time of observation. 0=not checked, 1=good, 2=inconsistent, 3=doubtful, 4=wrong, 5=data changed. |
| $Q_A$ | Location quality class (range of radius of 66% confidence)<br>0: >=1500m, 1: 500..1500m, 2: 250..500m, 3:<250m, /: not available |
| $Q_d$ | Quality control indicator for the section. 0=not checked, 1=good, 2=inconsistent, 3=doubtful, 4=wrong, 5=data changed. |
| $Q_x$ | Number of the only group of the section whose Quality Control indicator is not 1. Otherwise this group is coded 9. |
| ddff | Wind Direction (10 degrees), Wind Speed (m/s or Knots depending upon iw) |
| $s_nTTT$ | Air Temperature (1/10 C), sn=1 if <0, sn=0 if >0 |
| $s_nT_dT_dT_d$ | Dew-Point Temperature (1/10 C), sn=1 if <0, sn=0 if >0 |
| UUU | Air Humidity (%) |
| $P_oP_oP_oP_o$ | Air Pressure at station level (1/10 hPa) |
| PPPP | Air Pressure reduced at sea level (1/10 hPa) |
| appp | Characteristic of air pressure tendency, air pressure tendency in the last 3 hours (1/10 hPa/3H). **a** is coded as follows: 2=pressure is increasing; 4=pressure is steady; 7=pressure is decreasing. |
| $S_nT_wT_wT_w$ | Sea Surface Temperature (1/10 C), sn=1 if <0, sn=0 if >0 |

| | |
|---|---|
| $P_{wa}P_{wa}$ | Period of waves |
| $H_{wa}H_{wa}$ | Height of waves |
| $P_{wa}P_{wa}P_{wa}$ | Period of waves (1/10 s, accurate) |
| $H_{wa}H_{wa}H_{wa}$ | Height of waves (1/10 m, accurate) |
| $Q_{d1}$ | Quality control indicator for temperature salinity profile. 0=not checked, 1=good, 2=inconsistent, 3=doubtful, 4=wrong, 5=data changed. |
| $Q_{d2}$ | Quality control indicator for current speed and direction profile. 0=not checked, 1=good, 2=inconsistent, 3=doubtful, 4=wrong, 5=data changed. |
| $k_2$ | Indicator for salinity |
| $z_nz_nz_nz_n$ | Depth (m) |
| $T_nT_nT_nT_n$ | Water Temperature at depth (C, +5000 if <0) |
| $S_nS_nS_nS_n$ | Water Salinity at Depth (1/100 of psu) |
| $k_6$ | Method for removing ship's velocity and motion from current measurement |
| $k_3$ | Duration and time of current measurement |
| $z_nz_nz_nz_n$ | Depth (m) |
| $d_nd_nc_nc_nc_n$ | Direction (10 Deg), and Speed (cm/s) of Marine Currents at Depth |
| $Q_p$ | Quality control indicator for Air Pressure. 0=good, 1=bad. |
| $Q_2$ | Quality control indicator for the first housekeeping parameter. 0=good, 1=bad. |
| $Q_{TW}$ | Quality control indicator for the water-surface temperature measurement. 0=good, 1=bad. |
| $Q_4$ | Quality control indicator of the air temperature. 0=good, 1=bad. |
| $Q_N$ | Quality of the satellite transmission. 0=good, 1=doubtful. |
| $Q_L$ | Quality of Location (0=OK, 1=Latest known location). If the value is 1, then the date and time of the location fix is given by the groups YYMMJ GGgg of section 4. |
| $Q_A$ | Location quality class (range of radius of 66% confidence)<br>0: >=1500m, 1: 500..1500m, 2: 250..500m, 3:<250m, /: not available |
| $Q_z$: | Depth correction indicator. Indication whether probe depths as reported in Section 3 are corrected using hydrostatic pressure or not (0: not corrected, 1:corrected, /: missing). Code talbe 3318. |
| $Z_hZ_hZ_hZ_h$ | Hydrostatic pressure of lower end of cable. Pressure is expressed in units of 1000 Pa (i.e. centibars). If group $\underline{3}Z_hZ_hZ_hZ_h$ is present, then group $\underline{4}Z_cZ_cZ_cZ_c$ is mandatory. |
| $Z_cZ_cZ_cZ_c$ | Length of cable in meters (thermistor strings). |
| $B_tB_t$ | Buoy type: code table 0370 «Type of data-buoy» (BUFR table 0-02-150). e.g. 00:unspecified drifting buoy, 01=Lagrangian drifter, 02: FGGE, 03: Wind FGGE, 04: Ice float, 08: sub-surface float, 16: unspecified moored buoy, 17: NOMAD, 18: 3-meter discus, 19: 10-12 meter discus, 20: ODAS 30 series, 21:ATLAS, 22:TRITON, 24: Omnidirectional wave rider, 25: Directional wave rider, //:missing. |
| $X_tX_t$ | Drogue type: code table 4880 « Drogue Type » (BUFR table 0 02 034) (e.g. 01=Holey sock, 00:unspecified, //:missing) |
| $A_hA_hA_h$ | Anemometer height above station level (decimeters. A value of 999 shall be used to say that anemometer height is artificially corrected to 10 meters by applying a formula. ///: Unknown value. Group omitted if wind is not measured. |
| $A_N$ | Anemometer type (0:Cup, 1: propeller rotor, 2:WOTAN, /:missing). Group ommitted if wind is not measured. Code table 0114. |
| $V_BV_Bd_Bd_B$ | Speed and direction of the buoy at the last known position. Speed $V_BV_B$ is given in cm/s, and Direction $d_Bd_B$ is given in tens of degrees. |
| $V_iV_iV_iV_i$ | Housekeeping Parameter number i (up to 3 parameters) |
| $Z_dZ_dZ_d$ | Depth of the drogue (m) coded if requested by the Principal Investigator. |

Example of BUOY message:

```
ZZYY
12345 29013 0756/ 761567 022345 611//
11119 0//// 40145=
```

Platform WMO 12345 on 29 January 1993 at 7:56 UTC, 61.567N, 22.345W (good time and good location), Good Air Pressure=1014.5 hPa.

## C.2) SYNOP code (WMO code forms FM 12-XI Ext. SYNOP):

Report of surface observation from a land station. Used for reporting synoptic surface observations from a land station, manned or automatic.

Section 0 and 1 are mandatory, Sections 2 and 3 are optional.

Section 0:

**AAXX** **$YYGGi_w$**
**IIiii**

Section 1:

**$i_Ri_x$/VV** **/ddff** **(00fff)** **($1s_nTTT$)** { ($2s_nT_dT_dT_d$) or (29UUU) }

**($3P_oP_oP_oP_o$)** { (4PPPP) or ($4a_3hhh$) } **(5appp)** **($6RRRt_R$)**

**(9GGgg)**

Section 2:

**22200** ($0s_sT_wT_wT_w$) ($1P_{wa}P_{wa}H_{wa}H_{wa}$) ($2P_wP_wH_wH_w$) ($70H_{wa}H_{wa}H_{wa}$)
($8s_wT_bT_bT_b$)

Section 3:

**333** ($1s_nT_xT_xT_x$) ($2s_nT_nT_nT_n$) (4/sss)

(907tt 911ff (00fff))

Brief description of groups for SYNOP:

| | |
|---|---|
| **YYGGi$_w$** | Day in the month, Hour, Indicator for wind units (1=m/s, 4=knots) |
| **IIiii** | WMO Identification number |
| **i$_R$** | Indicator for precipitation data |
| **i$_x$** | Type of station (3:Manned, 6:Automatic) |
| **VV** | Horizontal visibility |
| **ddff** | Wind Direction (10 degrees), Wind Speed (m/s or Knots depending upon iw) |
| **fff** | Wind speed in units indicated by iw |
| **s$_n$TTT** | Air Temperature (1/10 C), sn=1 if <0, sn=0 if >0 |
| **s$_n$T$_d$T$_d$T$_d$** | Dew-Point Temperature (1/10 C), sn=1 if <0, sn=0 if >0 |
| **UUU** | Air Humidity (%) |
| **PPPP** | Air Pressure at mean sea level (1/10 hPa) |
| **P$_o$P$_o$P$_o$P$_o$** | Air Pressure at station level (1/10 hPa) |
| **appp** | Characteristic of air pressure tendency, air pressure tendency in the last 3 hours (1/10 hPa/3H). Refer to table number 200 of the WMO Manual on Codes, Volume I, WMO No 306, Part D, for the possible values of **a**. |
| **RRRt$_R$** | Precipitations, period for precipitations. Refer to WMO Manual on Codes for details. |
| **a$_3$hhh** | Isobaric surface (1:1000 hPa, 5:500, 7:700, 8:850), Geopotential (M Modulo 1000) |
| **GGgg** | Hour and minutes of time of observation if asynoptic time. |
| **s$_s$** | Sign and Type of Sea Surface Temperature measurement : |

| Code figure | Sign | Type of measurement |
|---|---|---|
| 0 | SST>0 | Intake |
| 1 | SST<0 | Intake |
| 2 | SST>0 | Bucket |
| 3 | SST<0 | Bucket |
| 4 | SST>0 | Hull Contact Sensor |
| 5 | SST<0 | Hull Contact Sensor |
| 6 | SST>0 | Other |
| 7 | SST<0 | Other |

| | |
|---|---|
| **T$_w$T$_w$T$_w$** | Sea Surface Temperature (1/10 C), sign is given by **s$_s$** |
| **P$_{wa}$P$_{wa}$** | Period of waves |
| **H$_{wa}$H$_{wa}$** | Height of waves |
| **P$_w$P$_w$** | Period of wind waves |
| **H$_w$H$_w$** | Height of wind waves |
| **H$_{wa}$H$_{wa}$H$_{wa}$** | Height of waves (1/10 m, accurate) |
| **s$_w$T$_b$T$_b$T$_b$** | Wet bulb or ice bulb temperature.<br>**s$_w$**: Indicator fo the sign and type (web/ice bulb) of web bulb temp.<br>**T$_b$T$_b$T$_b$**:Wet bulb or ice bulb temperature in 1/10 of Celsius. |
| **s$_n$T$_x$T$_x$T$_x$** | Maximal Temperature in the last 24 hours (1/10 C), sn=1 if <0, sn=0 if >0 |
| **s$_n$T$_n$T$_n$T$_n$** | Minimal Temperature in the last 24 hours (1/10 C), sn=1 if <0, sn=0 if >0 |
| **sss** | Total depth of snow (cm) |
| **tt** | Period of reference for wind gust ending at the time of observation (WMO Table 4077): 00= at the observation, 10=1 hour, 30=3 hours, 69=unknown. |
| **ff** | Wind Gust (m/s or Knots depending upon **i$_w$**) |
| **fff** | Wind Gust in units indicated by **i$_w$** if > 99 units. |

Example of SYNOP message:

AAXX 29061
07510 46/// /0723 10125=

Automatic Station WMO 07510 on 29 January 1993 at 06:00 UTC, Wind Direction = 70 Degrees, Wind Speed = 23 m/s, Air Temperature = 12.5 Celsius.

## C.3) <u>SHIP code</u> (WMO code form FM 13-XI Ext. SHIP):

Report of surface observation from a sea station. Used for reporting synoptic surface observations from a sea station, manned or automatic.

Section 0 and 1 are mandatory, Sections 2 and 3 are optional.

Section 0:

$\underline{\mathrm{BBXX}}$

$\left\{ \begin{array}{c} \mathrm{D\ .\ .\ .\ D} \\ \text{or} \\ A_1b_wn_bn_bn_b \end{array} \right\}$ $YYGGi_w$ $\underline{99}L_aL_aL_a$ $Q_cL_oL_oL_oL_o$

Section 1:

$i_Ri_x\underline{/}VV$ $\underline{/}ddff$ $(\underline{00}fff)$ $(\underline{1}s_nTTT)$ $\left\{ \begin{array}{c} (\underline{2}s_nT_dT_dT_d) \\ \text{or} \\ (\underline{29}UUU) \end{array} \right\}$

$(\underline{3}P_oP_oP_oP_o)$ $\left\{ \begin{array}{c} (\underline{4}PPPP) \\ \text{or} \\ (\underline{4}a_3hhh) \end{array} \right\}$ $(\underline{5}appp)$ $(\underline{6}RRRt_R)$

$(\underline{9}GGgg)$

Section 2:

$\underline{222//}$ $(\underline{0}s_sT_wT_wT_w)$ $(\underline{1}P_{wa}P_{wa}H_{wa}H_{wa})$ $(\underline{2}P_wP_wH_wH_w)$ $(\underline{70}H_{wa}H_{wa}H_{wa})$

$(\underline{8}s_wT_bT_bT_b)$

Section 3:

$\underline{333}$ $(\underline{1}s_nT_xT_xT_x)$ $(\underline{2}s_nT_nT_nT_n)$

$(\underline{907}tt\ \underline{911}ff\ (\underline{00}fff))$

Brief description of the groups for SHIP:

| | |
|---|---|
| **D ... D** | Ship's call sign |
| **$A_1b_wn_bn_bn_b$** | WMO Identification number |
| **$YYGGi_w$** | Day in the month, Hour, Indicator for wind units (1=m/s, 4=knots) |
| **$L_aL_aL_a$** | Latitude (1/10 degrees) |
| **$Q_cL_oL_oL_oL_o$** | Quadrant of the globe (1:NE,3:SE,5:SW,7:NW, Longitude (1/10 degrees) |
| **IIiii** | WMO Identification number |
| **$i_R$** | Indicator for precipitation data |
| **$i_x$** | Type of station (3:Manned, 6:Automatic) |
| **VV** | Horizontal visibility |
| **ddff** | Wind Direction (10 degrees), Wind Speed (m/s or Knots depending upon iw) |
| **fff** | Wind speed in units indicated by iw |
| **$s_nTTT$** | Air Temperature (1/10 C), sn=1 if <0, sn=0 if >0 |
| **$s_nT_dT_dT_d$** | Dew-Point Temperature (1/10 C), sn=1 if <0, sn=0 if >0 |
| **UUU** | Air Humidity (%) |
| **PPPP** | Air Pressure at mean sea level (1/10 hPa) |
| **$P_oP_oP_oP_o$** | Air Pressure at station level (1/10 hPa) |
| **appp** | Characteristic of air pressure tendency, and air pressure tendency in the last 3 hours (1/10 hPa/3H). Refer to the table number 200 of the WMO Manual on Codes, Volume I, WMO No 306, Part D, for the possible values of **a**. |
| **$RRRt_R$** | Precipitations, period for precipitations. refer to the WMO Manual on Codes for details. |
| **$a_3hhh$** | Isobaric surface (1:1000 hPa, 5:500, 7:700, 8:850), Geopotential (M Modulo 1000) |
| **GGgg** | Hour and minutes of time of observation if asynoptic time. |
| **$s_s$** | Sign and Type of Sea Surface Temperature measurement : |

| Code figure | Sign | Type of measurement |
|---|---|---|
| 0 | SST>0 | Intake |
| 1 | SST<0 | Intake |
| 2 | SST>0 | Bucket |
| 3 | SST<0 | Bucket |
| 4 | SST>0 | Hull Contact Sensor |
| 5 | SST<0 | Hull Contact Sensor |
| 6 | SST>0 | Other |
| 7 | SST<0 | Other |

| | |
|---|---|
| **$T_wT_wT_w$** | Absolute value of Sea Surface Temperature (1/10 C) |
| **$P_{wa}P_{wa}$** | Period of waves |
| **$H_{wa}H_{wa}$** | Height of waves |
| **$P_wP_w$** | Period of wind waves |
| **$H_wH_w$** | Height of wind waves |
| **$H_{wa}H_{wa}H_{wa}$** | Height of waves (1/10 m, accurate) |
| **$S_w$** | Sign and Type of Wet Bulb Temperature measurement |

| Code figure | Sign | Type of measurement |
|---|---|---|
| 0 | SST>=0 | Measured wet bulb temperature |
| 1 | SST<0 | Measured wet bulb temperature |
| 2 | / | Ice bulb measured wet bulb temperature |
| 3-4 | / | Not used |
| 5 | SST>=0 | Computed wet bulb temperature |
| 6 | SST<0 | Computed wet bulb temperature |
| 7 | / | Ice bulb computed wet bulb temperature |

| | |
|---|---|
| **$T_bT_bT_b$** | Absolute value of Wet Bulb Temperature Measurement in 1/10 of Celsius |
| **$s_nT_xT_xT_x$** | Maximal Temperature in the last 24 hours (1/10 C), sn=1 if <0, sn=0 if >0 |
| **$s_nT_nT_nT_n$** | Minimal Temperature in the last 24 hours (1/10 C), sn=1 if <0, sn=0 if >0 |
| **tt** | Period of reference for wind gust ending at the time of observation (WMO Table 4077): 00=at the observation, 10=1 hour, 30=3 hours, 69=unknown. |
| **ff** | Wind Gust (M/S or Knots depending upon $i_w$) |
| **fff** | Wind Gust in units indicated by $i_w$ if > 99 units. |

Example of SHIP message:

```
BBXX
12345 29061 99213 70432
46/// /0723 10125=
```

Automatic Marine station WMO 12345 on 29 January 1993 at 06:00 UTC, Latitude = 21.3N, Longitude = 43.2W, Wind Direction = 70 Degrees, Wind Speed = 23 m/s, Air Temperature = 12.5 Celsius.

## C.4) BATHY code (WMO code form FM 63-XI Ext. BATHY):

Report of bathythermal observation.

Section 1 and 4 are mandatory, Sections 2 and 3 are optional.

Section 1: **JJVV**
**YYMMJ** **GGgg/** $Q_cL_aL_aL_aL_aL_a$ $L_oL_oL_oL_oL_oL_o$
$(i_uddff)$ $(4s_nTTT)$

Section 2: $8888k_1$ $I_xI_xI_xX_RX_R$
$(z_oz_oT_oT_oT_o)$ $(z_1z_1T_1T_1T_1)$ ... $(z_nz_nT_nT_nT_n)$
(999zz $(z_1z_1T_1T_1T_1)$ ... $(z_nz_nT_nT_nT_n)$)

Section 3: 66666 $(k_5D_cD_cV_cV_c)$

Section 4: { **D .... D** or 99999 $A_1b_wn_bn_bn_b$ }

Brief description of the groups for BATHY:

| | |
|---|---|
| **YYMMJ** | Day in the month, month, year |
| **GGgg** | Hour, Minutes |
| $Q_cL_aL_aL_aL_aL_a$ | Quadrant of the globe (1:NE,3:SE,5:SW,7:NW, Latitude (1/1000 degrees) |
| $L_oL_oL_oL_oL_oL_o$ | Longitude (1/1000 degrees) |
| $i_uddff$ | Units used for wind speed, wind direction (10 Deg), wind speed |
| $s_nTTT$ | Air temperature (1/10 C), sn=1 if <0, sn=0 if >0 |
| $k_1$ | Indicator for digitization |
| $I_xI_xI_x$ | Instrument type for XBT with fall rate equation coefficients (see table 1770 from WMO Manual on codes (No. 306), Volume-I, part A) |
| $X_RX_R$ | Recorder types (see table 4770 from WMO Manual on codes (No. 306), Volume-I, part A) |
| $z_nz_nT_nT_nT_n$ | Depth (m modulo 100), Water Temperature |
| **zz** | Depth (100 m) |
| $k_5$ | Indicator for the method of current measurements |
| $D_cD_cV_cV_c$ | Direction of Surface Currents (10 Deg), Speed of Surface Currents (Knots) |
| **D ... D** | Ship's call sign |
| $A_1b_wn_bn_bn_b$ | WMO Identification Number |

Example of BATHY message:

```
JJVV
29013 0600/ 721222 043522
00723 40125
88887 04222 00124 10082
99901 50022
99999 12345=
```

Marine station WMO 12345 on 29 January 1993 at 06:00 UTC, Latitude = 21.222 North, Longitude = 43.522 West, Wind Direction = 70 Degrees, Wind Speed = 23 m/s, Air Temperature = 12.5 Celsius, Temperatures at selected depths: Surface:12.4 C, 10 meters: 8.2 C, 150 meters: 2.2 C.

## C.5) TESAC code (WMO code form FM 64-XI Ext. TESAC):

Temperature, salinity and current report from a sea station. Section 1 and 5 are mandatory, sections 2, 3, and 4 are optional.

Section 1: **KKYY**
**YYMMJ** **GGgg/** **$Q_cL_aL_aL_aL_aL_a$** **$L_oL_oL_oL_oL_oL_o$**
**($i_u$ddff)** **(4$s_n$TTT)**

Section 2: **888$k_1k_2$** **$I_xI_xI_xX_RX_R$**
($2z_oz_oz_oz_o$) ($3T_oT_oT_oT_o$) ($4S_oS_oS_oS_o$)
($2z_1z_1z_1z_1$) ($3T_1T_1T_1T_1$) ($4S_1S_1S_1S_1$)
. . . . . . . . .
($2z_nz_nz_nz_n$) ($3T_nT_nT_nT_n$) ($4S_nS_nS_nS_n$) (00000)

Section 3: ($66k_6k_4k_3$ ($2z_oz_oz_oz_o$) ($d_od_oc_oc_oc_o$)
($2z_1z_1z_1z_1$) ($d_1d_1c_1c_1c_1$)
. . . . . .
($2z_nz_nz_nz_n$) ($d_nd_nc_nc_nc_n$)

Section 4: (This section is not used with the Argos system)

Section 5: { **D .... D** }
{ or }
{ **99999** **$A_1b_wn_bn_bn_b$** }

Brief description of the groups:

| | |
|---|---|
| **YYMMJ** | Day in the month, Month, Year |
| **GGgg** | Hour, Minutes |
| **$Q_cL_aL_aL_aL_aL_a$** | Quadrant of the globe (1:NE,3:SE,5:SW,7:NW, Latitude (1/1000 Degrees) |
| **$L_oL_oL_oL_oL_oL_o$** | Longitude (1/1000 Degrees) |
| **$i_u$ddff** | Units used for wind speed, wind direction (10 Deg), wind speed |
| **$s_n$TTT** | Air Temperature (1/10 C), sn=1 if <0, sn=0 if >0 |
| **$k_1$** | Indicator for digitization |
| **$k_2$** | Indicator for salinity |
| **$I_xI_xI_x$** | Instrument type for XBT with fall rate equation coefficients (see table 1770 from WMO Manual on codes (No. 306), Volume-I, part A) |
| **$X_RX_R$** | Recorder types (see table 4770 from WMO Manual on codes (No. 306), Volume-I, part A) |
| **$z_nz_nz_nz_n$** | Depth (m) |
| **$T_nT_nT_nT_n$** | Water Temperature at depth (C, +5000 if <0) |
| **$S_nS_nS_nS_n$** | Water Salinity at Depth (1/100 of psu) |
| **$k_3$** | Duration and time of current measurement |
| **$k_4$** | Period of current measurement |
| **$k_6$** | Method for removing ship's velocity and motion from current measurement |
| **$d_nd_nc_nc_nc_n$** | Direction (10 Deg), and Speed (cm/s) of Marine Currents at Depth |
| **D ... D** | Ship's call sign |
| **$A_1b_wn_bn_bn_b$** | WMO Identification number |

Example of TESAC message:

```
KKYY
29013 0600/ 721223 043523 00723 40125
88871  04222 20000 30124 20010 30082 40035 20150 30022
99999 12345=
```

Marine station WMO 12345 on 29 January 1993 at 06:00 UTC, Latitude = 21.223 North, Longitude = 43.523 West, Wind Direction = 70 Degrees, Wind Speed = 23 m/s, Air Temperature = 12.5 Celsius, Temperatures at selected depths: Surface:12.4 C, 10 meters: 8.2 C, 150 meters: 2.2 C. Salinity at 10 meters: 35 psu.

## C.6) HYDRA code (WMO code form FM 67-VI HYDRA):

Report of hydrological observation from a hydrological station.

Section 1 is mandatory, other sections are optional.

| | | | | |
|---|---|---|---|---|
| Section 1: | **HHXX** | **YYGG** | **(000$AC_i$)** | **$BBi_Hi_Hi_H$** |
| Section 2: | **22** | **(/$H_sH_sH_sH_s$)** | | |
| Section 3: | **33** | **(/$QQQe_Q$)** | | |
| Section 4: | **44** | **($t_p$RRRR)** | (. . .) | (. . .) |
| Section 5: | **55** | **($ts_nT_tT_tT_t$)** | (. . .) | (. . .) |
| Section 6: | **66** | **(DDDss)** | | |

Brief description of the groups:

| | |
|---|---|
| **YYGG** | Day in the month, Synoptic hours |
| **$AC_i$** | WMO Regional association area, Country |
| **$BBi_Hi_Hi_H$** | Basin, National hydrological observing station identifier |
| **$H_sH_sH_sH_s$** | Stage (cm) |
| **$QQQe_Q$** | Discharge (first 3 digits of discharge in $dm^3/s$, exponent for QQQ) |
| **$t_p$RRRR** | Period for precipitations, Total amount of precipitations |
| **$ts_nT_tT_tT_t$** | Nature of the Temperature reading, Temperature of the element indicated by t (1/10 C), sn=1 if <0, sn=0 if >0 |
| **DDDss** | Ice thickness (cm), Depth of snow on ice (cm) |

Example of HYDRA message:

```
HHXX
2906 00019 17001
22 /0040
33 /1251
55 10123 3152
```

Hydrological station 17001 on 29 January 1993 at 06h00 UTC. Stage 40 cm; discharge 1250 $dm^3/s$; Air Temperature 12.3 C; Maximum Temperature in the last 24 hours 15.2 C.

## C.7) <u>BUFR code</u> (WMO code form FM 94-XI Ext. BUFR):

<u>B</u>inary <u>U</u>niversal <u>F</u>orm for the <u>R</u>epresentation of meteorological data:

**<u>BUFR</u>**

**Identification section**

**(Optional section)**

**Data description section**

**Data section**

**<u>7777</u>**

BUFR is basically a self defining binary code for exchanging meteorological data. A BUFR "message" is a contiguous binary stream composed of 6 sections. Section 0 contains the coded characters "BUFR" and Section 5 the coded characters "7777" indicating the beginning and the end of a BUFR message. Section 1, Identification Section, contains information about the contents of the data, such as type of data, time of data, and whether or not the optional Section 2 is included in the message. Section 3 contains the description of the data that is represented in Section 4. Standard BUFR descriptors defined in BUFR tables B, C, and D are used for that purpose. Refer to the WMO Manual on Codes, Volume 1, International Codes, WMO N° 306, Part B - Binary codes - for details.

## Annex D - Glossary

| | |
|---|---|
| ATLAS | Autonomous Temperature Line Acquisition System. TAO Array moored buoys deployed in the equatorial Pacific Ocean initially for TOGA. |
| BATHY | GTS code form used for bathythermal observations. |
| BCD | Binary Coded Decimal. |
| Bit | The smallest possible quantity of information, 0 or 1. |
| BUFR | Binary Universal Form for the Representation of meteorological data. |
| Bulletin | GTS Bulletin: set of GTS reports coded using the same GTS code form and grouped for GTS distribution. |
| Buoy | Drifting and moored buoys are automatic observing systems deployed in the oceans to gather geophysical data. |
| Calendar Day | The day of the year, e.g. 31 December is calendar day 365 in a non-leap year. |
| Checksum | The platform computes the sum of consecutive words from the platform message and inserts it in the message. When the GTS sub-system receives the sum, it re-calculates it and compares it with the sum in the message. If the numbers do not match, a transmission error has occurred: one or several bits are wrong. |
| CIM | Compression Index by platform Message, i.e. number of consecutive identical original platform messages from a platform during a satellite pass. |
| CIS | Compression Index by Sensor, i.e. number of identical data fields for a given sensor on a given platform, during a satellite pass. Identical fields are not necessarily consecutive. |
| Compensating sensor | Sensor used in conjunction with the transfer function of another sensor to calculate its geophysical value. For example an Air Pressure sensor can be compensated (corrected) by an internal temperature sensor because the temperature of the pressure sensor modifies its reading. |

| | |
|---|---|
| Data base | Organized data structure. |
| DBCP | Data Buoy Cooperation Panel. Joint body of the World Meteorological Organization (WMO) and of the Intergovernmental Oceanographic Commission (IOC). |
| Drifting Buoy | See buoy. |
| Drogue | Device attached to a drifting buoy either for the drifter to stay a long time in a given ocean area or for it to follow the water motion. |
| Flag | Binary descriptor (0/1, yes/no, good/bad, etc.). |
| FORTRAN | Programming Language. |
| FRGPC | French Argos Global Processing Centre (Toulouse). |
| Geomagnetic Variation | Difference between true North and Magnetic North, high in polar areas. Can be used to correct wind direction data when these are measured with reference to magnetic North. |
| Gray Codes | Sequence of binary words of N bits; successive words differ one from another in only one bit position. |
| GTS | Global Telecommunication System of the World Meteorological Organization, used by the meteorological centres to exchange data in real time all over the world. |
| Header | GTS Bulletin Header: identification section of a GTS bulletin used to route bulletin to a weather centre. |
| HYDRA | GTS code form used for hydrological observations from a hydrological station. |
| IOC | Intergovernmental Oceanographic Commission. |
| Julian day | Integer for a given date. Julian day 1 is 1 January 1950. The 26 November 1990 is the 14939th day after 1 January 1950; its Julian day is therefore 14939. |
| Lagrangian drifter | Drifting buoy designed to follow water motion. Used to measure sea surface current. |

| | |
|---|---|
| MEDS | Marine Environment Data Service, Canada. |
| Modulo | Modulo operator on integer numbers: remainder of the Euclidian division of two integer numbers, i.e.<br>(R = A mod B) <==> (A=B*Q + R with R<B). |
| Moored buoy | See buoy. |
| NDBC | National Data Buoy Center of NOAA, Stennis Space Center, Mississippi, USA. |
| NOAA | National Oceanic and Atmospheric Administration, USA. |
| NFP | National Focal Point for Drifting Buoy Programmes. |
| Observation | Set of geophysical measurements from a transmitter at a given time. |
| PGC | Principal GTS Coordinator. Designated by the Principal Investigator of an Argos programme as point of contact to request any status changes the Argos User Office is to do on platforms reporting onto the GTS. |
| PI | Principal Investigator (e.g. in drifting buoy programs, usually the platform owner). |
| PTT | Argos Platform Transmitter Terminal or Argos platform. |
| PTT message | Coded set of informations sent by a PTT to the satellite. Argos message. |
| QC | Quality Control. |
| Raw data | Original binary values of sensors as coded in the Argos messages. |
| Report | GTS Report: platform observation coded in a GTS message using a GTS code form. |
| RMS | Root Mean Square. |
| SHIP | GTS code form used for surface observations from a sea station. |

| | |
|---|---|
| SYNOP | GTS code form used for surface observations from a land station. |
| Synoptic observation | Observation done at a specific synoptic time. Synoptic times are 00:00, 03:00, 06:00, 09:00, 12:00, 15:00, 18:00, 21:00 UTC. |
| TAO | Tropical Atmosphere-Ocean. |
| TC DBCP | Technical Coordinator of the Data Buoy Cooperation Panel. |
| TOGA | Tropical Ocean and Global Atmosphere Programme. |
| USGPC | US Argos Global Processing Centre (in Largo). |
| UTC | Universal Time Coordinated. |
| WMO | World Meteorological Organization. |
| WMO number | Platform Identification Number used for international exchange of data on the GTS. |
| WOCE | World Ocean Circulation Experiment. |
| Word | A set of contiguous bits from a given regular sensor, timer or checksum. |
| Xor | Exclusive logical bit by bit or operator (0+0=0, 0+1=1, 1+0=1, 1+1=0). |

# Annex E - References


Argos User Manual.

WMO Manual on Codes, Volume 1, International codes, WMO No. 306, Part A - Character Codes.

WMO Manual on Codes, Volume 1, International codes, WMO No. 306, Part B - Binary Codes.

WMO Manual on the Global Telecommunication System, No. 386.

DBCP Guide to data collection and location services using Service Argos, DBCP document series.

**TECHNICAL DOCUMENTS ISSUED WITHIN THE DATA BUOY COOPERAYION PANEL SERIES**

| No. | Title | Year of issue |
|---|---|---|
| 1 | Annual report for 1994 | 1995 |
| 2 | Referenbce Guide to the GTS Sub-system of the Argos Processing System - Revision 1 | 2001 |
| 3 | Guide to Data Collection and Location Services using Service Argos | 1995 |
| 4 | WOCE Surface Velocity Programme Barometer Drifter Construction Manual - Revision 1 | 2001 |
| 5 | Surface Velocity Programme - Joint Workshop on SVP Barometer Drifter Evaluation | 1996 |
| 6 | Annual report for 1995 | 1996 |
| 7 | Developments in Buoy Technology and Enabling Methods - Technical Presentations Made at the Eleventh Session of the DBCP | 1996 |
| 8 | Guide to Moored Buoys and Other Ocean Data Acquisition Systems | 1997 |
| 9 | Annual Report for 1996 | 1997 |
| 10 | Developments in Buoy Technology and Communication Technologies | 1997 |
| 11 | Annual report for 1997 | 1998 |
| 12 | Developments in Buoy Technology and Data Applications | 1998 |
| 13 | Annual report for 1998 | 1999 |
| 14 | Variety in Buoy Technology and Data Applications | 1999 |
| 15 | Global Drifting Buoy Observations - A DBCP Implementation Strategy | 1999 |
| 16 | Annual Report for 1999 | 2000 |
| 17 | Developments in Moored and Drifting Buoy Design, Programmes, Sensors, and Communications - Presentations at the DBCP Technical Workshop | 2000 |
| 18 | Annual report for 2000 | 2001 |
| 19 | Developments in Buoy Technology, Communications and Data Applications - Presentations at the DBCP Scientific and Technical Workshop | 2001 |

These publications can be ordered from: Etienne charpentier, Technical Coordinator of DBCP and SOOP, JCOMMOPS, Parc Technologique du Canal, 8-10 rue Hermes, F-31526 Ramonville Saint-Agne, France - *Internet mail*: charpentier@jcommops.org - *Telefax:* +33-5 61 75 10 14 - *Telephone:* +33-5 61 39 47 82